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CONTRIBUTION ON THE LIFE HISTORY AND ECOLOGY OF THE NINE-BANDED ARMADILLO

BY F. WALLACE TABER

This report is on certain phases of the life history and ecology of the armadillo, *Dasypus novemcinctus mexicanus* Peters, in Texas. Literature pertaining to this animal is restricted largely to treatises on embryology, histology, endocrinology, and food habits. The field of ecology is almost untouched. Even the extremely fragmentary briefs on natural history are for the most part folklore, with few records of actual observations.

METHODS OF COLLECTING DATA

Questionnaires.—From questionnaires sent out under the auspices of the Texas Game, Fish and Oyster Commission, I learned much relative to increase of range, population densities, detrimental and beneficial qualities, public sentiment, and effects of drought and cold upon armadillos.

Pen Observations.—Because of the difficulty of close field observations, I found it advantageous to supplement the field work with observations on captive armadillos.

In October 1938, a holding pen was constructed at the poultry farm, Agricultural and Mechanical College of Texas. A 7-foot wire fence (5 feet above ground and 2 below) inclosed 240 square feet. A small pen, 4 feet square, was constructed within the larger one. This one was completely roofed and floored, beneath 2 feet of ground, by heavy mesh wire. Within this smaller pen was buried a nest box, 2 feet square, leaving the hinged top flush with the surface of the ground to permit observations of the resting armadillos. Entrance into the nest box was gained by means of a wooden runway with only the opening exposed at the surface of the ground. No bottom was used.

Later I found it necessary to attach a strip of wire netting a foot wide, and projecting downward and inward, completely around the top of the outside pen to prevent the armadillos from climbing over, a feat they could do with ease. Peculiarly enough, they could not climb down after having reached the top of the fence. They seemed not at all disconcerted, however, about dropping to the ground. Upon several occasions captives were observed to climb to the guard fence, sniff the air awhile, and then fall to the ground only to climb back

again. It seemed to make little difference whether the landing was effected on the feet, back, or head.

Field Work.—Field work was carried on in Texas from September 1938 to June 1939. Many observations were rechecked from September 1939 to February 1940. Field work was done in several different types: East Texas Piney Woodland, Edwards Plateau, Coastal Prairie, and Post Oak. Lack of time prevented close examination of all distinct vegetative and soil types of Texas, but efforts were made to secure information from all. A trip to Chambers County, Texas, afforded opportunity for censusing dens on the coastal prairies.

Armadillos are stupid animals in many respects. To follow one about the forest or field as it diligently probes for buried insects requires but slight precaution. My first attempts at armadillo stalking met with failure, but before long I had acquired a knack that, although inexplicable, was nevertheless effective. On several occasions I followed an armadillo for as much as half an hour, never more than a few feet away. In cold weather, armadillos were active during the middle of the day and observations were more easily made then, whereas in warmer weather they were active mainly at dusk and after nightfall.

Because of the high concentration of armadillos in many localities, it was not difficult to conduct field work over a relatively large area. There was, indeed, no lack of materials during most of the study.

Photographing armadillos under natural conditions was extremely difficult because of dense vegetation and extreme nervousness of the creatures. Seldom would they remain in one position long enough for me to focus the camera.

ENVIRONMENTAL RELATIONS

Climate.—Available data suggest that in the 1850's the armadillo was restricted in Texas to the Lower Rio Grande Valley from the vicinity of Ringgold Barracks east to the mouth of the Rio Grande (Baird, 1857). By 1880 apparently it had extended its range as far north as Frio City in Frio County and as far east as the Nueces River (Cope, 1880). When Vernon Bailey conducted his survey of the mammals of Texas at the turn of the century, he reported the species as occupying a much larger range than either of the previous authors. He says (Bailey, 1905), "... armadillos are strictly Lower Sonoran, but in the rough country between Rock Springs and Kerrville they range fairly into the edge of the Upper Sonoran Zone." During the past four decades there has been an even more decided extension of range to include a considerable portion of the Upper Sonoran Zone.

On the Edwards Plateau (Upper Sonoran Zone), armadillos are commonly found along creek beds where digging is facilitated by loose alluvial soil. On the W. L. Moody ranch in Kimble County, they were common along creek beds, among limestone cliffs, and on the juniper covered hills.

Armadillos have been reported as fairly common in Reagan County, practically all of which is included in the Upper Sonoran Zone; also, in Cochran, Hockley, Lamb, and Bailey counties on the high plains.

Climate, in the form of temperature, doubtless plays the greatest restrictive rôle in limiting the range of the armadillo. High temperatures seem effective

only in causing their activities to be confined largely to the cooler hours of darkness; low temperatures have the opposite effect, bringing them abroad during the hottest part of the day in search of food.

Early on the night of January 6, 1939, a heavy frost settled over our camp near Junction, Kimble County. Before morning the temperature dropped below freezing. That evening and the next morning I spent three hours looking for armadillos without success. The air was so cold that my fingers were numb. Shortly after the sun hit the valley at 10:00 a.m., however, I encountered several armadillos. Soon they were so numerous in the valley that I caught three with ease. Meantime, the temperature had increased until the briskness was completely gone from the air. Two hours later it clouded up and began to rain. Armadillos continued to feed, oblivious to the rain. At 4:00 p.m., the sun went behind a cloud, the wind shifted, and a "norther" set in. I saw my last armadillo about ten minutes before the norther struck and when we left two days later, with the norther still persisting, they had not emerged from their dens.

Occasionally cold periods are of long duration, severe enough to prevent armadillos from feeding during even the hottest part of the day. Those armadillos that become established during the warmer parts of the climatic cycle beyond the limit of their tolerance for cold are completely wiped out by a single cold spell of sufficient duration. This is especially true when the ground is frozen for several days. William J. Tucker, Executive Secretary of the Texas Game, Fish and Oyster Commission, told me that upon at least one occasion, when snow covered the ground, he had found armadillos frozen within a few rods of their dens. In such instances cold acts as a decided barrier to their spread.

I have found no evidence that heat has any direct effect upon armadillos except, as stated above, to restrict their activities to the cooler night hours. Heat does, however, exert a definite influence by drying the soil to such a degree that probing is difficult or impossible. As the soil becomes baked and food either dies or is forced so deep into the soil as to become unavailable, armadillos get thin and may finally starve to death. A long drought, such as the one experienced in the Kerrville region from 1932 to 1935, greatly reduces the armadillo population. In Edwards County they were nearly extirpated by drought during the summer of 1935. According to Game Warden Menke of Cuero, Texas, armadillos were extremely numerous in Live Oak County before the severe drought of 1916 nearly exterminated them. By 1932 they were again numerous, but the severe drought following left few survivors.

Consequently, temperature does exert a limiting effect on armadillos. Newman (1913) suggested that lat. 33° N. was the limit of their northward extension, winter temperatures being too cold beyond that latitude to permit permanent establishment. Blair (1936) says that such is not the case, for armadillos have already emigrated into Oklahoma and Arkansas by way of the Red and Arkansas River valleys. Randolph Peterson of Denton County, Texas, informed me of a colony of armadillos that has been in that section of the state for at least seven years. Armadillos have also been reported from Fannin, Lamar, and Red River counties. All of these localities are north of 33° N. lat. Along a six or seven mile stretch on the east side of the Little Wichita River in Archer County (north

of 33° N.) they have increased in the last few years. Although scattered colonies will doubtless survive in the more sheltered places north of lat. 33° N., low temperatures are likely, in time, to exterminate them or at least to keep their numbers at a minimum.

Soil.—It is difficult to detect the direct effects of soil upon an animal with such an extensive range as that of the armadillo. In Texas they occur from the rough stony lands of the Pecos region to the rich, alluvial Ochlockonee of the Sabine River Valley and from the blackland prairies of the north to the sandy coastal prairies of the Gulf. The presence of numerous creeks and streams, all bringing in fingers of alluvium into otherwise unsuitable areas of soil, erase exact boundaries.

As with other burrowing mammals, soil texture exerts a definite influence upon the number of armadillos present in a given area. Those soils that are more diggable, other factors being equal, will doubtless contain the greater population densities. Availability and abundance of food also play a definite part, but the choice of food is so varied that, except during the most adverse periods of cycles, it is far less restrictive than is soil.

The greatest population density of armadillos with which I am familiar is in Walker County where the soils are sandy. Field workers for the Texas Cooperative Wildlife Research Unit estimated that in Walker, Polk, and bordering counties in 1937–1938 these animals occurred at the rate of one armadillo to three acres. The sandy soils that occur over much of the East Texas piney woodlands are readily diggable, yet firm enough to prevent caving.

Brazos County is typical of the post oak type in which soils are heavily impregnated with clay and become packed during dry seasons. Lay (MS) estimated one armadillo to ten acres in that county, but there the presence of numerous creek and stream banks has noticeable effects. Near Kurten, Brazos County, I found two armadillos per acre; in Colorado County in the same post oak type, I found one to 50 acres. The only noteworthy difference between the two areas was the relative absence of creeks in the latter and an abundance of them in the former.

On the coastal prairies of Chambers County I found one armadillo to 4.5 acres. The diggability of the soil was greatly increased by the presence of scattered mounds in which the soil was more sandy than in the remainder of the area.

Armadillos are extremely scarce in the clayey blackland soils. Those that live there usually burrow in stream banks and feed in the alluvial bottomlands, seldom probing for food in the true blackland soils. One colony of which I have record, however, was located in the black, clayey soil of an abandoned field, but such records are rare.

In the hill country of Edwards Plateau armadillos are fairly abundant. There they live both in alluvial bottoms and in the shallow limestone soils of the uplands. The limestone, however, has numerous cracks and caves that require little digging to make them suitable for dens. Thus, this habitat favors a larger population of armadillos than is able to exist in the blackland prairies.

Soils seldom exert a limiting effect insofar as dens are concerned, for armadillos can dig in extremely compact soils. Soil type is not nearly so important in

restricting the distribution of armadillos as is soil texture. A certain degree of limitation is exerted, however, by the availability of food. Insects may be present in plenty, yet the sun baked, clayey soils sometimes make probing so difficult that considerable time is required for securing each morsel of food. These conditions were obvious after a prolonged drought in Brazos County where I saw several emaciated armadillos.

Soil drainage is important to burrowing mammals, for in poorly drained soils they may be drowned in periods of heavy rainfall. On the Aransas Refuge, Aransas County, armadillos were not abundant despite the presence of sandy soil. The area is relatively flat and much water stands on or near the surface during the rainy season. This same condition exists near College Station, Brazos County, where water often stands in the burrows continuously for several weeks in winter, rendering them useless.

Water.—Armadillos are found in areas miles from water, yet my experience shows that they require water. Those kept in the holding pen and deprived of water for five days drank ravenously when it was offered to them. So thirsty were they that their fears were completely overcome. Newly captive armadillos that previously had not allowed me to approach near them drank without the slightest hesitation while I held them in my hands. One individual drank continuously for four minutes before its attention was turned to escaping from my grip, which apparently had bothered it not at all while its thirst remained.

Tracks in the mud surrounding small ponds gave evidence of numerous visits by armadillos; some for drinking, some for feeding, and some for mud baths.

Most armadillo dens studied were dug in stream banks proper, probably because of better cover and easier digging rather than nearness to water. In the banks of many intermittent streams, dens were inhabited irrespective of whether water was present. After continued drought, however, a slight concentration of armadillos around the remaining water holes suggested small local migrations, possibly influenced by water shortage elsewhere. With the return of water, vacated dens were again inhabited.

Excess of water likewise exerts a limiting effect on armadillos. A 10-foot rise on a small stream under observation completely inundated many burrows. Usually such rises occur with sufficient slowness to allow the armadillos to move out, but on occasion the rise is sudden and they are doubtless trapped in their dens. Mortality from such floods must be extremely low for the animals are good swimmers.

Plants.—Plants are important to the armadillo chiefly as cover. Sites among the roots of youpon bushes are preferred for burrows in the post oak type; they burrow, however, among the roots of haws, shrubby oaks, osage orange, and many other bushy plants. Protection seems to be the prime requisite, with preference shown individual plants rather than species. More depends upon the location and the extent of root growth than upon the species.

On the D. W. Williams' ranch, Brazos County, I had the opportunity to witness in detail an area before and after the brushy cover had been removed to increase the land's value as pasture. Prior to clearing operations, armadillos were abundant over the entire area; after the clearing program was completed,

they became scarce and no burrow left exposed by brush cutting was thereafter occupied. A strip of cover averaging 50 feet in width was allowed to remain along a stream that traversed the area. Armadillos from the cutover area moved into this strip, venturing forth under cover of darkness into their former haunts in search of food. Grass came up in the cleared area and the number of probings showed food to be more plentiful there than before the clearing, yet no armadillos denned in the tract.

Some plants doubtless have a greater invertebrate fauna beneath their canopy than others, yet I was unable to determine any preference of cover made by the armadillo purely because of food supply. Probings appeared as often beneath one species of plant as another.

INFLUENCE UPON ENVIRONMENT

Erosion.—I have already mentioned the armadillo's preference for den sites along stream banks where digging is easier and exposed roots afford protection. With the brush clearing campaign advocated by the U. S. Agricultural Adjustment Administration and practiced quite extensively over much of Texas, this preference leaves the armadillo open to criticism. In some localities brush is the only soil binder present. When it is removed, grass is either slow coming in or it is grazed so close that it has no chance to grow. In such instances armadillo dens along dry washes and creek banks left exposed to tramping cattle are sources of erosion. Early stages of gully erosion sometimes begin in armadillo dens thus situated.

On the Williams' ranch, along the banks of two small streams separated by a wide, wooded flat, I noted that armadillo burrows were quite numerous. Many dens were exposed later when a brush clearing program completely removed the cover from part of the flat and one stream bank. Clearing operations ceased, however, before the second stream was reached, thus affording a check on the resulting effects to exposed dens along stream banks and on the intervening flat.

A month after the brush cutting and previous to the first rain, many of the burrows that no longer had bushes growing over them had been caved in by grazing cattle.

Several days of continuous rain later brought a 10 foot rise on the two streams. With subsidence of the flood waters, the exposed dens in the flat held small puddles of water, whereas those in the cleared stream bank showed soil slumpage. The wading of cattle through the muddy soil, and the flowing of small rivulets of flood waters from the burrows back into the stream, added materially to the erosion.

Two weeks later a second rainy period of less intensity raised the water once more well above the dens. When the bank burrows were again revealed, they had turned into small ditches leading 3 or 4 feet down to the stream. In three instances the ditches had lengthened up hill and in one place a trough about 6 inches wide and 4 inches deep led to the top of the bank where a well-worn cow trail fed water into it.

Three months later a gully some 3 feet deep and 20 feet long occupied the

place of the last mentioned bank burrow. Cows were using the gully for a path. Subsequent rains doubtless added to the depth of the path and hastened erosion. Armadillo dens along the wooded stream showed no sign of erosion despite periodic floodings.

Incorporation of Organic Matter Into Soil.—The average armadillo nest will fill a bushel basket; one that I unearthed at College Station, Brazos County, consisted of nearly two bushels of damp, decomposing vegetation. This decaying vegetable matter adds materially to the humus content of the soil, while the dens themselves doubtless have much effect in letting in water and air to otherwise heavy and somewhat impervious soil.

A 10 foot rise in a stream on the Williams' ranch inundated several bank burrows for over a week without destroying them. When the water had subsided and the dens had partially dried, armadillos returned, cleaned out the wet and rotting nests, fashioned them into mounds at the entrances of the burrows, and made new nests of dry material. Decomposition of the discarded material was greatly accelerated by the large amount of mud that was dug out at the same time. Humus thus formed is close enough to the surface to be available to germinating seeds.

According to game warden Emil Habecker of Bandera County, armadillos are seldom found dead above ground; even when shot, they usually find their way into a burrow before dying. He has excavated many dens and found decomposing bodies curled within the nests. During extreme drought periods, he has found as many as three to a den. Soil is doubtless enriched by these decomposing carcasses.

DENS AND NESTS

Few animals of comparable size have so many dens per individual as does the armadillo. A close check of the population on the D. W. Williams' ranch revealed one animal to 4.5 dens; on the coastal prairies the number was one to 8.5. Not only does the armadillo excavate a hole in which to live, but it digs several others that serve various purposes.

On the College Farm, the majority of dens found along the intermittent wash and creek banks were inhabited, while those located on the level ground back from the banks were shallow, and probably were used only for emergency shelter or as food traps. In the sandy soil of the East Texas piney woodlands, inhabited dens were found everywhere—along the creek banks, in dry washes, and on level ground. Digging is relatively easy there and banks are not essential for burrow sites. On the coastal prairie the sandy knolls contain the majority of dens, more because of protection from flood than because of diggability. In the Edwards Plateau area natural caves, cracks, and crevices among the limestone cliffs and rocks afford abundant shelter and few excavated burrows were encountered except in the rich alluvium of the bottomlands. Even there, because of frequent floods, dens were few.

Dens vary from 2 to 15 feet in length, and from a few inches below the surface to 4 feet deep. Usually the burrows are branched. One excavated in Chambers

County was forked and had a nest in each section, while two others with three side branches had but a single nest. Those with two or three entrances usually had but one in use. When dens were isolated on knolls, presence of two nests and several entrances showed that on occasion the dens were connected. Near Stubblefield Lake, Walker County, I found dens grouped together with as many as twelve entrances in a knoll. F. R. Adams, a resident of that region, said that as many as three nests were found in a single mound of dens and that once he found five adult armadillos in such a mound. Burrows that I excavated in Brazos County had a single entrance, with the deepest nest 2½ feet below the surface. Near the mouth of Pinto Creek in Kinney County, an armadillo sought refuge in a burrow so shallow that its tail protruded from the entrance. When I dug into the den, it proved to be 2 feet long and about 10 inches below the surface. Despite the shallowness, it contained a nest of mesquite leaves, grass, and weeds.

The method employed by armadillos in digging is rather unique. Both the nose and the forefeet are utilized in loosening the soil which is then pushed into a small pile beneath the abdomen. Pausing momentarily, the armadillo balances on forefeet and tail, meanwhile placing both hind feet simultaneously over the pile. In this position the body is strongly arched and a sudden tension of the muscles straightens the animal, lifts the hind end off the ground, and, as both hind feet are moved backwards in a sudden thrust, throws the pile of soil several feet from the entrance to the burrow. The extremely sharp cutting edges of the claws and the short muscular legs enable the armadillo to dig with amazing rapidity. A captive completely buried itself in two minutes in soil so packed that I required a pick with which to dig it.

Once within a hole, an armadillo is practically impossible to extract. Although its tail offers an excellent handhold, the body can be so arched that the plates dig into the walls and efforts to remove the animal seem only to lodge it more securely. Newman (*op. cit.*) says that the tail will break before the animal will relax its hold. By working one's hand down into the burrow, however, and seizing the edge of the carapace, one can finally get the animal out.

Apparently the nest is always located at the extreme end of the burrow, usually in a somewhat enlarged, dome-shaped chamber. On occasion, however, they are pushed nearer the surface because the lower parts of the burrows are flooded. All dens do not have nests; some are only a foot or so deep and possibly serve as food traps.

Nesting materials vary according to the dry vegetation available. South of Stowell, Chambers County, spartina grass was used extensively along with berry and persimmon leaves. On the Williams' ranch, nests were composed of Bermuda grass in addition to many kinds of leaves. Captive armadillos utilized corn shucks, which I furnished them, to fill their nest box. One large, sick female, unable to get into the nest box, built a nest in an empty wooden box in one corner of the pen. She raked in every piece of vegetation available within a radius of three feet.

Armadillo nests have no structure, the nest chamber merely being stuffed with

dry vegetation, into the center of which the animal pushes its way. I had four females and one male using the same nest box in my holding pen. They were apparently quite sociable and unconcerned about the opposite sex out of breeding season. I have never found more than one adult inhabiting the same nest in the wild, but Adams' observation, cited previously, shows that more than one armadillo may inhabit the same nest at least during a part of the year. The young often remain in the same den with the mother until several months old, even though they are weaned. Kalmbach (1943) says that females with young may den together. On one occasion he dug 12 young armadillos from a single den.

From the beginning I was puzzled as to the manner in which my captive armadillos transferred two bushels of corn shucks 6 feet across the holding pen and down the runway into an underground nest box. To ascertain the method used, I removed all the shucks from the nest box, placed them in the opposite corner of the cage, and spent part of the following night observing the activity. Even before darkness fell, the five animals began to carry the shucks back. With the fore feet, they raked a small pile of shucks well back beneath the body, allowing it to rest on top of the hind feet. While doing this, the body was highly arched, fore feet off the ground, and balanced by means of the tail. When a small pile of material had been raked into place, the body was lowered, clamping the shucks into position, and the animal slowly backed toward the entrance, its tail extended backward as though tactile in function. When the entrance was reached, the tail swung into the hole and the armadillo slowly backed down, raking any dislodged shucks back into position with its fore feet and nose.

DAILY AND SEASONAL MOVEMENTS

During the winter when rain stands in puddles on the surface of the ground, there is a decided movement of armadillos to higher and drier terrain. These moves are short and a return is usually effected as soon as the wet season passes.

During dry seasons there is likewise a distinct local movement to creek and stream banks where probing is facilitated by the more moist soil. Also, forms of food other than insects are secured from ponds, which dry up during that period.

Besides seasonal movements, there are some daily ones of importance. A movement under the cover of darkness away from the thickets and out onto the open pastures is noticeable. Also, in extremely dry weather resting periods are interrupted when armadillos leave their burrows and, pig-like, search for a pond in which to wallow. Such mud baths, although I have not observed them, are plainly evidenced by tracks and by imprints of the carapace left stamped in the mud. On hot days the captive armadillos sometimes took baths in their drinking trough.

Experience with captive animals indicates that armadillos do not hibernate. Captives that had been forced by cold weather to remain in their nest box as long as three days were active when disturbed. On several extremely cold days I lifted them from the warm nest and carried them into the pen. When released,

they stood sleepily and shook violently, then ran for the nest. During prolonged cold spells the captives left their nest box only long enough to visit the feeding trays. Apparently the carapace is little protection against cold, for even on moderately cold days they shivered noticeably. This observation supports the conclusion that cold may be the most important factor in restricting their range.

As pointed out above, on hot days armadillos normally prefer evening and night hours for feeding, seldom venturing from their burrows during the hotter hours of the day. Cold weather reverses this daily cycle. All possible intergradations likewise occur, depending, of course, upon the temperature. Usually during winter they feed in greatest abundance around midafternoon. If the temperature rises sufficiently to break the cold spell for a few days, the cycle reverts to the normal weather routine. Rain, unless accompanied by cold weather, has little effect on armadillos except in bringing them out to feed much earlier than normally. Shortly after a summer rain they were found feeding two or three hours ahead of the regular period.

Seasons in this southerly latitude are not sufficiently pronounced to cause a decided yearly cycle. A definite daily cycle, dependent upon temperature, occurs, however, and it may vary from one extreme to the other within a few days.

FECES

Armadillo scats are typically spherical, about the size of a marble, and to the casual observer nothing more than mud balls. Upon close examination, however, these balls are seen to be composed of hundreds of elytra, carapaces, legs, heads, antennae, and other indigestible insect parts held together by means of soil incidentally ingested. Invariably, animals that extract insects from the ground swallow some soil.

So far as I have been able to ascertain, armadillos never defecate in their nests, nor do they have definite toilets within their burrows or favored spots without. I have found scats lying within burrows, but more often they lie scattered along runways leading from it. Although I have seen several pellets dropped at once, I have not found more than two or three in a spot. Deer feces, which resemble that of the armadillo, are usually deposited in piles and individually retain their shape because of their vegetable composition, whereas those of the armadillo do not.

One young armadillo, which I caught in the Navasota River bottom, defecated violently as I held it by the tail; slimy, black mud streamed from the anus and ran down the abdomen. Doubtless this armadillo had been feeding along the edges of the many nearly-dry, intermittent ponds and, while probing for food, had ingested mud which passed through the digestive tract without assuming the usual ball form.

An adult female which was kept captive for several weeks became so tame that she could be turned out of the holding pen and allowed to forage in the field. On two occasions she was liberated on the mound of a colony of red ants (*Pogonomyrmex comanche*), with the thought that the manner in which ant hills were

opened could be witnessed. Immediately she began to dig a hole in the ant mound, but instead of burying her snout to feed, she turned, squatted over it, and defecated. When finished, she scratched soil into the hole with her hind feed, and, not turning to look back, began feeding several feet away from the mound. The next day when I released her on another red ant mound, she repeated the act. I have since learned that armadillos seldom feed on this species of ant. In fact, ants in general are usually not eaten nearly so much as are ant larvae and pupae.

SWIMMING

On January 6, 1939, I caught an adult male armadillo on the banks of a large, deep lake in Kimble County. Despite the kicking and clawing, I managed to throw it out into the lake about 40 feet from shore. Its head, which appeared above the surface after a second or two, was shaken twice before the animal began to swim in a small circle. When headed in the right direction, the armadillo swam to the nearest point of land. As it neared shore I could clearly see the alternate, dog-fashion kicking of all four feet. Periodically it raised its nose to breathe and then lowered it again into the water. Its ears were laid close against its head and none of the body appeared above the surface of the water. As its feet came in contact with the shore, it walked out on dry land, shook off the water, and attempted to run away.

Three times I threw the animal into the water. Each time it returned with no noticeable ill effects other than fatigue. The fourth time, I carried it out about 70 feet onto the cement dam, the top of which was nearly flush with the water. From there I threw it into the lake again. When it came to the top, it looked very tired as it slowly shook its head, laid back its ears, and, after a short circle, headed for the far shore some 50 or 60 feet away. In all, the armadillo swam about 175 feet before escaping.

Near Huntsville, Walker County, I caught an immature animal that was probing near the edge of a small shallow tank. Wishing to determine the method it would employ to get out of the tank, I threw it about 20 feet from shore where the depth was no more than a foot. Immediately it appeared on the surface and dog-fashion, with only the crown of the head above the water, struck out for the opposite shore. Twice before the shore was reached its nose was raised to breathe. The second time I threw it into the pond it failed to reappear after the splash. The first indication of its presence was a ripple near the opposite bank as its nose appeared at the surface. Without hesitation the animal ran out onto land and attempted to escape. Two more trials revealed that when the animal became tired it could not hold its breath so long. The last time I threw it in it walked about half the distance under water, then came to the surface and swam to shore. Swimming was noticeably slower than walking on the bottom.

Kalmbach (1943) found that after being returned several times to the water armadillos apparently swallowed sufficient air to make them buoyant. I was unable to verify this.

The presence of armadillos on Bloodworth Island, in the Gulf of Mexico a short distance off the coast of Aransas County, suggests that they may at times swim in salt water.

FOOD IN CAPTIVITY

Although more than 90 percent of the food of the wild armadillo consists of insects, in captivity it will eat nearly anything offered. At first, armadillos placed in the holding pen refused to eat. Usually for the first three or four nights they preferred to probe the soil after their accustomed manner. It was not long, however, before they began to visit the feeding trough where bone and fish meal thoroughly mixed with mash and soured milk were provided. The mixture was soon relished.

Armadillos were slow to learn how to eat dead chickens. After a few days, however, chicken carcasses were scraped clean overnight, especially when the visceral cavities were first opened and the viscera exposed. The lack of teeth in the fore part of the armadillo's jaw proved a decided handicap in feeding on flesh. Once a part of intestine or muscle had been scratched loose sufficiently to allow the molariform teeth to clamp down on it, the problem was practically solved. Using their fore feet to hold the meat against the ground, the animals tugged and pulled, relaxing now and then to claw at the tangled mesentery, until the morsels were loosened. The sharp toe nails were used to scratch the meat from small bones.

I had little difficulty in securing an abundance of dead chickens, since the holding pen was located on the College Poultry Farm. Several times I allowed flies to blow the carcasses and, after the maggots were several days old, dumped the entire squirming mass into the pen. This seemed a choice item; fresh chickens were passed up in favor of the maggot-infested carrion.

Contrary to reports, armadillos refused chicken eggs unless they were first broken. A set of five bantam eggs in a dummy nest placed in the center of the pen remained untouched by five armadillos for 21 days.

Water was a necessity and was usually sought first when the animals left their nest box to feed. After a short drinking period, the surface of the water would be covered with froth from the sticky, saliva-coated tongue. They also liked milk, lapping it up dog-fashion with their long protrusible tongues.

Watermelons and cantaloupes were eaten only when broken, and only then when other food was lacking. Corn, scratch feed, and wheat remained untouched even when soaked in water or fish oil. Bread soaked in the same oil, however, was quickly devoured. Beets, both sweet and Irish potatoes, onions, and turnips remained untouched for over a month; apparently they are never eaten.

Kalmbach (1943) has adequately discussed the natural foods of armadillos.

FEEDING MOVEMENTS AND PROBING

Since terrestrial insects form the bulk of the armadillo's diet, a specialized method for procuring them is employed. This method is termed 'probing' and requires the use of both forefeet and the elongated snout. Variations in the

moisture content and diggability of the soil shift the brunt of the probing from the nose, as in loose sandy or muddy soil, to the feet, in more densely packed clays and silts. In soil of average diggability the nose is pushed into the surface litter as far as possible and when an insect is detected, a conical hole is quickly dug by short, alternate strokes of the forefeet. With each thrust of the feet, the nose is pushed deeper into the soil, not once being lifted from the probe while digging is in progress.

The armadillo is admirably fitted for securing food in this manner. Its feet are heavily clawed, its nose prolonged into a narrow, well protected snout, its mouth terminal, and its tongue long, protrusible, and provided with a sticky mucous secretion for gathering in small and possibly otherwise unavailable insects.

Probing depths varied with the location. In the sandy soils of Walker County, 46 probes averaged 3.6 inches deep with extremes of 2.5 and 6 inches. In the hard-packed clay loam of Brazos County 21 probes averaged 3.1 inches, with extremes of 1.5 and 3 inches. In Brazos County a second count made in the immediate vicinity of a chain of intermittent ponds showed 19 probes to average 4.1 inches in depth, with extremes of 2.5 and 6.5 inches. On Bloodworth Island just off the coast of Aransas County, the course of a feeding armadillo was easily followed as it zig-zagged down the beach. A deep probe of 6.5 inches occurred about every 17 inches for a distance of more than 100 yards.

As previously expressed, feeding hours vary according to the temperature. Regardless of the feeding hours, however, the feeding movements are usually similar. Seemingly on impulse an armadillo will walk or run, stopping abruptly to sniff and then to probe. Occasionally feeding is interrupted as the animal rears up on its hind feet to test the air for danger.

No definite direction is assumed in feeding, neither is a straight course followed away from the den. Often individuals travelled in circles, working some areas twice. The search for food is initiated at the very mouth of the burrow and at times the animal may forage several hundred feet away. In the course of the search, several shallow burrows (insect traps perhaps) may be visited. No routine path is followed and insect traps are visited only when encountered in the regular hunt for food.

Their ability to locate insects beneath 5 or 6 inches of soil is uncanny. I have watched an armadillo shuffle quickly across the forest floor with its nose ploughing a furrow through the litter down to mineral soil. A sudden halt and sniff initiated a probe resulting in the capture of a beetle larva. Hesitating only sufficiently long to crush and swallow the grub, the animal continued its ploughing.

In one place where an old decaying log had added deep humus to the soil, I found the ground honey-combed with probes so close together as to lose all individual shape. The base of such bunch grasses as *Andropogon saccharoides* is a favorite probing site, as is also the soil beneath decomposing piles of cow dung, which are usually well worked for beetle and fly pupae.

In regions where both hog-nosed skunks and armadillos occur, their probes are often confused. The difference is readily recognized, however, for the

skunk must make a larger and more slanting hole in order to get the buried insect. This is correlated with the broader nose of the skunk. Rabbits also dig small conical holes, but these are seldom more than an inch deep and usually reveal nibbled roots.

APPEARANCE AND BEHAVIOR OF YOUNG

Patterson (1913), Hamlett (1932), and Newman (1913) have discussed adequately the breeding habits of armadillos.

The young are produced in a rather advanced stage of development, outwardly differing from the adults only in smaller size and more pliable carapace. The eyes are open at birth and the animals are capable of walking when only a few hours old (Apelt, *in litt.*). The period during which the young are suckled has not been recorded, but Charles Apelt of the Apelt Armadillo Farm, Comfort, Texas, takes the young from the mother at three or four weeks of age and feeds them on cow's milk.

Even before weaning, the young ones learn to probe and habitually accompany their mother in search of insects. On April 21, 1939, I caught three young ones not more than a few weeks old. Their carapaces were still soft and their legs weak, yet they were probing for food. From the appearance of the mother's teats they were not weaned. They showed no fear and when I kneeled, concealing the burrow, they attempted to root beneath my legs to get back into the home den.

In order to recognize the same individuals again, I banded all three with Biological Survey bands. It was necessary to punch a hole through the carapace just above the right hind leg and clamp the bands tight. After banding, I liberated them near the home den and immediately they began to probe, showing no fear of me nor pain from the bands. On May 11 they were still at the same home den with the mother. The two I saw more plainly still retained the bands with no apparent ill effects to animal or band. Two weeks later spider webs across the entrance of the burrow indicated that the den had been deserted by the entire family. They were never seen again.

ANIMAL ASSOCIATES

In attempting to ascertain the animals closely associated with the armadillo, a number of burrows were excavated. On the coastal prairies of Chambers County, Dan W. Lay, of the Texas Game, Fish and Oyster Commission, and I dug out 50 armadillo dens. In that area the land is nearly flat and, during the rainy season, inundated, save for scattered knolls that rise from 2 to 5 feet above the general level of the land and support sparse stands of brushy vegetation, usually heavily entwined with berry vines. A reconnaisance showed that dens occurred only on these knolls. Of 67 knolls examined (approximately 22.7 acres) 51 contained one den each. Of these, 36 were empty, some because of standing water. The remaining 15 dens contained the mammals listed in Table 1.

In one den an armadillo shared its burrow and nest with a cotton rat and a cottontail rabbit. In another instance an armadillo and an opossum occupied

the same nest. The nest had been moved to within a foot of the surface so that both animals were dry although the deeper parts of the burrow were flooded. The skunk had taken over an apparently deserted burrow and the burrowing owls were flushed from partly excavated armadillo burrows.

From the above it is apparent that armadillos are of some importance in the welfare of other animals. Dan Lay on one occasion found a mink inhabiting an armadillo den, and opossums and skunks on several occasions.

Tracks, pellets, and hair showed that nearly every den had been used by cottontails at one time or another, either for escape cover or as a resting place. On several occasions I have witnessed cottontails escape from hunters and twice from dogs by a hasty retreat down armadillo burrows. Dens excavated in heavy growths of berry vines invariably have well beaten trails leading to their entrances. In this way dense briar patches are made more accessible to rabbits. In one such tangle I flushed a covey of quail that had been using the paths of armadillos for shelter during the mid-day resting period. A novel use for armadillo dens was exhibited during the hunting season when a crippled quail, which I pursued, escaped by entering one.

TABLE 1.—*Contents of 15 armadillo dens excavated in Chambers County, Texas*

KIND OF ANIMAL	NUMBER	ACRES PER ANIMAL
Armadillo	6	3.8
Opossum	5	4.5
Cottontail	5	4.5
Cotton rat	4	5.6
Striped skunk	1	22.7
Burrowing owl	2	11.4

Peculiarly enough I have been unable to find parasites in the alimentary tract of the armadillo. Price (1926) in discussing the life history of an acanthocephalid parasite (*Oncicola canis*), the adult stage of which is found in dogs, says that ". . . . establishing the identity of acanthocephalid larvae collected by Dr. Albert Hassall from the nine-banded armadillo . . . , has shown that the armadillo serves as an intermediate host for *O. canis*." One armadillo that I collected on the College Farm had a single larval cyst of this parasite in the abdominal muscles.

External parasites are likewise few. Armadillos are bothered neither by fleas, body lice, nor mallophaga, all of which infest the average mammal. In all my field work, I discovered not a single case of tick infestation; possibly the horny carapace is ample protection against the sucking mouth parts of the tick. I was surprised, however, at the absence of ticks on the under parts, around the ears, neck, and head. Twice I have found ticks in the stomachs of armadillos; these probably were ingested accidentally.

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NOTES ON MAMMALS OBSERVED IN THE PERRY RIVER DISTRICT, QUEEN MAUD SEA

BY ANGUS GAVIN

It was my privilege to be stationed as Post Manager at the Perry River post, (Lat. 67° 48′ N., Long. 102° 10′ W.), of the Hudson's Bay Company from April 1937 to July 1941. My stay was interrupted by sick leave from August 1939 to March 1940.

To the south lay an unmapped and unexplored territory lying between the coast and Backs River. I made my first journey into the interior in March 1938 when I accompanied hunters of a tribe of Caribou Eskimos to the Garry lakes, returning alone about two weeks later. This was a traverse of 85 miles, and, I am told, is the first penetration of the territory by a white man.

The territory from the Ellice River to Sherman Inlet is generally flat and marshy. Many rivers not shown on maps flow into Queen Maud Sea from innumerable lakes, large and small, that dot the landscape in every direction. Here and there, low hills, rising to about 600 feet, relieve the general flatness. Inland one encounters a succession of ridges which tend to run east and west, gradually increasing to 2000-3000 feet high. The highest mountains are in the vicinity of the Garry lakes.

Between these ridges, varying in width from ¼ to 8 or 10 miles, are flat valleys with so many marshes, lakes and streams that one's general impression is that there is more water than land. In the summers of 1938 to 1941 inclusive, I journeyed into the interior for varying distances up to 30 miles. At this season the hills are a blaze of color—red, yellow, orange and gray-green lichens and white, yellow and purple heather. In the valleys are acres of white Arctic cotton but glorious patches of color are made by a blue forget-me-not-like flower, by red Arctic poppies and purple dryas. In the valleys grass, about a foot high,

grows abundantly in the marshy places while the tundra is green with mosses upon which the caribou feed. On the hills and in the valleys the prostrate Arctic willow commonly occurs. August is the most colorful month in the Arctic summer. The vegetation makes remarkably rapid growth after the ground is exposed in early June. The first growth starts in the marshes, in the river mouths, and in the valleys. Flying along the coast and looking back into the interior, one's general impression is of innumerable lakes, marshes and streams which form an ideal waterfowl breeding ground about 120 miles wide and approximately 80 deep.

Off the coast are literally thousands of small islands, only a few of which are shown on existing maps. These islands are the favorite fawning places of the Barren-ground caribou and the nesting places of ducks, geese and gulls. The geology is Pre-Cambrian throughout, with patches here and there of sedimentary rocks. The average mean temperature from November 1 to March 1 is −38°F. The average mean temperature from March 1 to November 1 is probably 30°F. The lowest temperature recorded by me in four years was −58°F.; the highest 80°F. in the shade in July 1937. The average temperature in July and August at midday would be about 50°F. High winds are of frequent occurrence and commonly reach a velocity of 50 miles per hour, or more, during the winter months. High winds are less frequent in summer and do not reach such high velocities. Breakup in the rivers takes place from June 5 to 14, but the sea ice persists throughout the year, except in August and September, which are the only months when the sea is clear. At times during these two months, north winds drive heavy pack ice into the gulf, completely blocking it.

Located 15 miles inland from the Perry River is a band of about 35 Eskimos of the Kogmuit tribe. The hunters of the tribe number 10. Kogmuit means "the people who live at the place of the swans" or, more briefly, "the swan people." The Eskimo names given in the annotated list are the ones in use by this tribe. Their name for Perry River is Kog-yuak, meaning the place of the swans.

In the preparation of these notes I wish to make grateful acknowledgement of assistance from Dr. R. M. Anderson, Chief, Division of Biology, National Museum of Canada, Ottawa; Mr. J. Dewey Soper, Chief Federal Migratory Bird Officer, Prairie Provinces, Winnipeg, Manitoba; and B. W. Cartwright, Chief Naturalist of Ducks Unlimited (Canada), Winnipeg, Manitoba.

ANNOTATED LIST OF MAMMALS

Barren Ground Caribou, *Rangifer arcticus arcticus* (Richardson): Eskimo, "Tuk-too".

According to the natives, caribou have increased considerably during the last 15 years. A similar increase has been noted in the territory around Bathurst Inlet. Caribou are resident throughout the year on the mainland but the winter population is about 75 percent less than that of summer. First arrivals from the south on migration appear from March 15 to 31. The movement reaches its peak in the first 15 days of May. They scatter over the surrounding country and on to the coastal islands to breed. Comparatively few continue north to breed on Nordenskjiold Island and on the islands and mainland of south-eastern Victoria Island. Thousands of islands around the shores of Queen Maud Sea, not shown

on maps, are favorite breeding places for caribou. The densest breeding population is found on Kent Peninsula. The young are born in June, usually a single fawn; occasionally two.

The islands appear to be favored fawning places probably because the gray wolf is rare or absent from them and mosquitoes are much less numerous. The caribou on the mainland suffer severe mortality from the attacks of mosquitoes. Many animals are found dead with the flesh around their eyes and muzzels raw and the heads swollen to twice their normal size. Larvae of some insect render the skin useless in spring. Dr. R. M. Anderson of the National Museum of Canada informs me that specimens of the larvae of the bot-fly, *Oedemagena tarandi* (Linn.), were collected by the Canadian Arctic Expedition, 1913–16. They were responsible for the damage to the caribou skins. The skin is perforated, sometimes with hundreds of holes where the larvae have emerged.

The southward migration takes place about the end of August or the first week in September. The animals swim from island to island and so to the mainland, but more often the ice is strong enough to carry them to the mainland. The herds move along the coast and are joined by those from the islands and the movement follows a regular route. The passage of the animals may be seen for 10–14 days, particularly at Bathurst Inlet. The moving columns extend as far as the eye can see.

Musk-ox, *Ovibos moschatus moschatus* (Zimmermann): Eskimo, "Oo-mee-muk".

Not numerous—seen in twos or threes, three or four times each year. The largest herds seen were 12 and 15 in May 1938 on the mainland just west of Flagstaff Island.

Barren-ground Bear, *Ursus* subsp.: Eskimo, "Uk-shuk".

A pair of grizzlies was encountered on the sea ice in March 1938 by an Eskimo named Kilerk, 15 miles west of the Perry River. He shot one of them with a 25–20 Winchester rifle and the skin was delivered to me. This skin was transferred to W. Gibson, at the Hudson's Bay Company's post at Coppermine this summer by the motor ship Fort Ross. This is the only occurrence of the Barren-ground grizzly that has come to my attention in the four years at Perry River.

Polar Bear, *Ursus maritimus* (Phipps): Eskimo, "Nanook".

Fairly common when the "big ice" comes from the north into the gulf. In years when the "big ice" does not come in, the polar bears are rare or entirely absent. In years of "big ice" as many as 20 skins will be offered at the post and these are only a portion of the bears killed. The natives encounter them on the ice, on the islands, and along the coast. They do not find them inland.

Arctic Weasel, *Mustela arctica subsp.*: Eskimo, "Ter-riak".

Common in years of lemming abundance and less common when lemmings are scarce. Only one form of "ermine" has been seen by me in this locality. Dr. R. M. Anderson informs me that Degerbøl (1935) records specimens examined from Kent Peninsula and King William Island as intermediate between the eastern *Mustela a. semplei* (Degerbøl's *M. a. labiata*) and the western subspecies *Mustela a. arctica*.

Wolverine, *Gulo luscus luscus* (Linnaeus): Eskimo, "Kal-vik".

Quite common in summer and winter in the hills west and south of the mouth of Perry River. In winter they are seen more frequently on the flat tundra. They follow the traplines.

Red Fox, *Vulpes fulva* subsp.: Eskimo, "Ki-uk-tuk".

Not common, but they are found in the same restricted localities every year. About 20 skins a year are brought in by the Eskimos. The cross fox occurs in about equal numbers

with the red, but only two silver fox pelts were brought to me in my four years' stay at Perry.

White Fox, Blue Fox, *Alopex lagopus innuitus* (Merriam): Eskimo, "Ter-ahguniak", "Kern-nuk-tuk".

Abundant in years of lemming abundance and scarce when lemming are scarce. The blue phase occurs in a ratio of 1 to 100 whites. Varying shades of blue are encountered—from a pale slate to a dusky blue.

About the end of March 1938, at my request, nine females with young were dissected by Eskimos under my guidance, and the unborn young in each female counted. One of the females had 23 foetuses about two-thirds developed, another had 17, and the balance 4 to 8. In the field, when the young are out of their dens, the usual size of litter observed ranges from 4 to 6, occasionally 7 or 8.

A disease attacks the foxes (and also the Eskimo dogs) in years of fox abundance. The symptoms are: the first day the dogs eat little or refuse food; second day they will not eat at all, and a mucus discharge from the nostrils is seen; about the third day they froth at the mouth and, when they attempt to stand up, rock back and forth as if intoxicated; on the fourth day they lose all sense of direction and go around in circles and finally fall over and die. They rarely survive longer than the fifth day after the first symptoms are noticed. Sometimes death occurs within two or three days. The white foxes are affected in a similar manner.

Gray Wolf, *Canis lupus tundrarum* (Miller): Eskimo, "Amar-oak".

Abundant in attendance on the caribou herds especially in late summer and fall. Rare on the islands, the favorite fawning locations of the caribou. Black or "blue" wolves are seen in a ratio of about 1 to 100. They are invariably leaders of the pack. I have never seen any evidence of the disease that attacks the husky dogs and foxes affecting the wolves. Young are born in late June or early July. I have noticed four to a litter.

Parry Ground Squirrel, *Citellus parryii parryii* (Richardson): Eskimo, "Chik-chik".

Abundant in the sandy country at the mouths of rivers and along the coast where burrowing is easy. Colonies are found on suitable sandy knolls; they are rarely seen inland in the Perry River district.

Back Lemming, *Lemmus trimucronatus trimucronatus* (Richardson): Eskimo, "Evingak".

Abundant everyone on the tundra and the coastal islands. Goes through cycles of abundance about every four years. From about April 27 to May 7, 1937, I witnessed a mass migration of brown lemmings while engaged in transporting stores from the old post site—at the mouth of the Perry river to the new site on Flagstaff Island, a distance of about 12 miles. While camped at the old post site on April 27 and for about four days subsequently, the onset of the migration was noticed. The whole tundra was a mass of moving lemmings and each time we went into the tent there would be a dozen or more inside. The migration went on night and day; my 13 dogs outside the tent could be heard killing them at frequent intervals during the night.

When we started for the new post, the sea ice was covered with a moving mass of lemmings, all headed in an easterly direction. They stopped at nothing. Untold thousands plunged over the ice into the water of a lead, about a foot below, and swam the 10 or 15-foot channel, but were unable to climb up the sheet ice on the other side. They perished in large numbers in these leads, but here and there, they found passages up the ice and blindly continued their journey. Around the ends of the leads they pressed on without interruption going through the pools of water, lying on the surface of the ice without deviation and without the slightest hesitation. This scene extended as far as we could see in any direction. The natives later informed me that at Kol-gyuakè—a river 45 miles east of Perry—

the same thing was going on at the same time. I do not know how far west it extended, but it was the same for at least 15 miles west of the post. This mass migration lasted for about 10 days and reached its peak about May 3 or 4.

In travelling from the old post to the new, my dogs grabbed up and ate so many lemmings while they were running that their stomachs distended to a noticeable degree. They were so surfeited that they were useless for further work until they had gotten over their abnormal feeding. I had to rest them for 24 hours to allow them to get over their gluttony. An estimate of the average density of lemmings during this migration would be one to the square yard.

In 1934 on King William Land, I witnessed a migration of lemmings but not anything like the extent or density of the one recorded above. On this occasion the direction of the movement was south to the Adelaide Peninsula.

Collared Lemming, *Dicrostonyx groenlandicus richardsoni* (Merriam): Eskimo, "Av-in-gak".

The white lemming found in the Perry river district is referred to the above subspecies on the grounds of geographic probability. This lemming is abundant but is not seen as often as the brown lemming in winter. This may be due more to its white coloration rather than to its apparent relative scarcity. It does not appear to go through the wide fluctuations in numbers that characterize the brown lemming.

Meadow Mouse, *Microtus* sp.: Eskimo, "Av-in-gak".

Not common but is well distributed on the tundra. This mouse has a tail about 2½ inches long, prominent ears, dark brown back, and is lighter underneath.

Arctic Hare, *Lepus arcticus andersoni* (Nelson): Eskimo, "Ok-a-lirk".

Usually common but shows wide fluctuations in numbers from year to year without definite periodic cycles. Individuals in the Perry district weigh as much as 9 pounds. A specimen from Bathurst Inlet weighed about 13 pounds. They are preyed upon by foxes and the wolverine.

Ringed Seal, *Phoca hispida* (Schreber): Eskimo, "Nat-chirk".

Quite abundant in Queen Maud Sea.

Bearded Seal, *Erignathus barbatus barbatus* (Erxleben): Eskimo, "Oog-yuk".

Quite plentiful in the Queen Maud Sea. They favor the shallower waters along the coast and islands. This and the ringed seal are the only species of seals noted by me in the Queen Maud Sea.

Hudson's Bay House, Winnipeg, Manitoba.

THE MAMMAL COLLECTIONS OF NORTH AMERICA

By J. Kenneth Doutt, A. Brazier Howell and W. B. Davis

The May 1923 number of the *Journal of Mammalogy* contained an interesting summary of the Mammal Collections of North America by Brazier Howell. Twenty years have elapsed since then, and in that time so many changes have taken place in the mammal collections of North America that it has seemed desirable to revise the list. In presenting the original article, Howell adequately summed up the situation in the following words:

"The larger museums are relatively sufficient unto themselves as regards research material; but the smaller ones, as well as unattached individuals, are often handicapped by their inability to secure, either by purchase or loan, specimens which they may badly need for investigations. The primary purpose in compiling this list is to indicate possible sources from which such material may be obtained. Even though a collector may have but a few score skins, he is usually willing to make an effort to secure species needed by a fellow enthusiast. Another effect which it is hoped the appearance of this list will have is the stimulation of the interest of the small collector, the beginner and the amateur. Few will undervalue the importance of gaining recruits for the study of mammalogy, for new blood is always needed in any line and can usually be secured, in natural history, only from the amateur field. A great incentive for increase of interest is in exchanging, which pastime has been largely instrumental, I am convinced, in building up the ranks of zoölogical enthusiasts. As the laws against the collecting of birds and eggs become more stringent, an increasing number will bend their natural history tendencies towards the study of mammals, and such should be given every possible encouragement.

"Practically all museums are anxious to further research in every way, but their staffs are too busy for them to loan material to individuals except in special cases, nor are they, as a rule, able to undertake exchanges. Most private collectors are willing to exchange and to loan material to responsible parties. A few of the individuals herein listed have just begun gathering collections of mammals, but although these collections are now small, they will doubtless grow, and should be mentioned; others, with only a few skins on hand, habitually collect for institutions. In the case of private collections, the numbers given are usually only approximate, and do not take into consideration such skins as have been sent away in exchange."

At the 1940 meetings of the American Society of Mammalogists, held in Denver, Colorado, J. Kenneth Doutt suggested that the work of bringing the survey up-to-date be undertaken by the Society. After some discussion, Dr. W. P. Taylor, then president of the Society, appointed a Committee, consisting of A. Brazier Howell, W. B. Davis and J. Kenneth Doutt, Chairman, to undertake the survey.

In preparing the list we have followed Howell's original plan to make it a roster of mammal collectors, as well as collections, and we hope that its effect may be to stimulate interest in the science of mammalogy, especially among young collectors. At the suggestion of Dr. Harold J. Coolidge, Jr., we have tried to include material on mammalian photography, for we believe that many of the most valuable life history records can be made on film, especially motion picture film, and that more and more attention will be given to this method of recording life history studies.

It was originally intended to have this report cover all of North America. Since no replies were received from Mexico or Central America, this report actually covers only the United States and Canada. Dr. Charles E. Bunnell, President of Alaska College, was unable to give us any information about that collection, because no one is in charge of the Museum at the present time. A single questionnaire was returned from South America. Dillon S. Bullock of El Vergel, Angol, Chile, states that the Escuela Agricola has a collection of about 100 specimens from the Provence of Malleco, Chile.

Considerable effort was made to locate every mammal collection in this country, and to that end a questionnaire and plea for information were published in the February number of the Journal of Mammalogy for 1942. A copy of the questionnaire is reproduced in figure 1, with the hope that it may be of assistance

QUESTIONNAIRE

If any question cannot be answered at once give an approximate answer and mark it as such. Please send promptly to J. K. Doutt, Carnegie Museum, Pittsburgh, Pa.

I. Have you (or has the institution with which you are connected) a collection of mammal study skins, skulls, skeletons, or preserved specimens? Yes ( ) No ( )

1. If so, how many ———— if collection consists largely of mounted specimens, so indicate.....
2. The specimens comprising the bulk of the collection are from what localities (States and Provinces in United States and Canada; counties for the rest of the world)....
3. Are any genera represented particularly well.....
4. How many type specimens have you?.....
5. Have you, or has the institution with which you are connected, a collection of mammal:
   a. Photographs Yes ( ) No ( )
   b. Slides Yes ( ) No ( )
   c. Kodachrome transparencies Yes ( ) No ( )
   d. Motion picture film Yes ( ) No ( )
6. Any remarks you can make concerning the extent of this material will be appreciated

Name of person answering this questionnaire.....
Address.....
Name of person, institution or organization to which the collection belongs (if not the same as above).....
Address.....

II. The Committee will be grateful for the names and addresses of any persons, colleges, organizations or institutions having collections of mammals. Please use the back of this questionnaire if you need more space. We thank you.

J. K. Doutt, Chairman
A. B. Howell
W. B. Davis

Fig. 1. Questionnaire used in North American Mammal Collection Survey

in interpreting the information on the charts. From this source only 35 replies were received so it was felt that some other method must be adopted. From all available sources a list was compiled of 513 names of individuals and organizations suspected of having mammalian material. Three hundred twenty-three replies were received as a result of the 513 questionnaires sent out, which, together with the 35 received through the Journal of Mammalogy, made a total of 358 replies. Sixty of these reported "no collection."

After considerable thought, and some experimentation, we finally decided to present the data in chart form, and to group the collections under countries, then states or provinces, rather than in a straight alphabetical list. An index follows the charts.

In some cases we were unable to get replies from persons whom we knew had collections. Where the information we had seemed to justify it, we included those collections in the list. In a few instances the information furnished by some of the larger museums was too extensive to be given in the charts. For these collections, a more detailed account is presented in the notes at the end of the article.

A comparison of the material assembled for the present report and the data published by Howell in 1923, reveals that many interesting changes have taken place in the past 20 years. It is regrettable, but we think inevitable, that the figures used in the summaries cannot be accurate. In spite of our efforts to make the list complete, we suspect that many small collections have been overlooked. On the other hand, some of the collections listed here have already gone out of existence. Then, too, additions are constantly being made to museum collections. Even while this paper was in manuscript form the Carnegie Museum collection increased from 21,500 to 22,500 specimens, and other institutions have undoubtedly increased their collections to a similar, or, perhaps, greater extent. Therefore, although we have treated these summaries as if they were exact, it must be remembered that they are only approximations. With this thought in mind, however, we have proceeded to make a few simple analyses of the data we have assembled.

	1923	1943
Total number of collections listed	77	297
Total number of specimens listed	410,239	939,483
Total number of private collections	40	113
Total number of specimens in private collections	32,245	77,914
Total number of public collections	37	184
Total number of specimens in public collections	377,994	861,569

There are 179 collections which contain 0—500 specimens
" " 29 " " " 501—1000 "
" " 43 " " " 1001—5000 "
" " 19 " " " 5001—or more "

270 Total number of collections

The above figure of 270 differs from the total of 297 collections listed, because in 29 instances the number of specimens was not given, not known, or the collections contained only photographic material.

From the above summary it appears that there are now more than three times as many collections as there were when Howell published his paper in 1923. The number of specimens in collections has more than doubled. The number of private collections is more than two and one-half times greater, while public collections are almost five times as common as they were in 1923.

In spite of the great increase in the number of public and private collections, it is interesting to note that 7 percent of the collections contain 85 percent of the specimens. In other words, by far the greatest bulk of the mammalian material is in a few, large collections. The 25 largest collections are listed below, in order of size.

*1. Biological Surveys Mammal Collections	138,130
*2. American Museum of Natural History	125,358
3. University of California, Museum of Vertebrate Zoology	100,027
*4. United States National Museum (exclusive of Biol. Surveys Mammal Colls.)	97,086
*5. Museum of Comparative Zoölogy (Harvard University)	52,000
6. Chicago Natural History Museum	50,000
*7. University of Michigan, Museum of Zoology	40,000
8. Academy of Natural Sciences of Philadelphia	22,000
9. Carnegie Museum	21,500
10. D. R. Dickey Collection (California)	20,000
*11. University of Michigan, Laboratory of Vert. Biol.	20,000
12. Cleveland Museum of Natural History	18,200
*13. National Museum of Canada	17,131
14. University of Kansas	14,098
15. San Diego Society of Natural History	13,477
16. Royal Ontario Museum of Zoology	13,000
17. California Academy of Sciences	9,000
18. Los Angeles Museum	9,000
19. State Game & Fish Commission (Mississippi)	5,966
20. Ellis, Ralph (California)	5,000
21. Provincial Museum (British Columbia)	4,800
22. Chicago Academy of Sciences	4,500
23. Milwaukee Public Museum	4,055
24. Colorado Museum of Natural History	4,000
25. University of Utah	4,000
Total number	812,328

A geographical summary of collections also reveals some interesting facts, as shown by the following list of states and provinces, with the number of private and public collections in each.

*See Notes, p. 266.

UNITED STATES

STATE	PUBLIC	PRIVATE	TOTAL
California	19	19	38
New York	10	6	16
Michigan	12	3	15
Washington	5	10	15
Ohio	8	2	10
Pennsylvania	8	2	10

STATE	PUBLIC	PRIVATE	TOTAL
Illinois	5	4	9
Florida	2	6	8
Minnesota	7	1	8
Oregon	1	7	8
Colorado	6	1	7
Massachusetts	7	0	7
Vermont	3	4	7
Connecticut	6	0	6
Maryland	2	4	6
Arizona	3	2	5
Iowa	4	1	5
Kansas	4	1	5
Texas	4	1	5
Utah	4	1	5
Virginia	4	1	5
West Virginia	1	4	5
D. C.	4	0	4
Indiana	4	0	4
Maine	3	1	4
Montana	2	2	4
New Hampshire	3	1	4
New Jersey	1	3	4
North Dakota	2	2	4
Georgia	0	3	3
Idaho	1	2	3
Kentucky	2	1	3
Nebraska	3	0	3
New Mexico	3	0	3
Oklahoma	2	1	3
Wisconsin	3	0	3
Alabama	2	0	2
Louisiana	2	0	2
Mississippi	2	0	2
Nevada	1	1	2
North Carolina	2	0	2
South Dakota	2	0	2
Wyoming	2	0	2
Arkansas	1	0	1
Delaware	1	0	1
Missouri	1	0	1
South Carolina	0	1	1
Tennessee	1	0	1
Rhode Island	0	0	0
Total	168	95	263

CANADA

Ontario	4	8	12
British Columbia	3	3	6
Manitoba	1	2	3
Alberta	0	1	1
Saskatchewan	0	1	1
Total	8	15	23

List of Mammal Collections

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES		
Alabama					
Alabama Coöperative Wildlife Research Unit, Auburn	30	—	Ala.	—	Photographs on file with U. S. Fish & Wildlife Service
Alabama Polytechnic Institute, Dept. of Zool.-Entomology, Auburn	345	—	Ala., Ga., Mich., Calif.	—	—
Arizona					
Dille, Fred M., Nogales	122	—	Sand Hill region of north central Nebr.	Peromyscus	—
Grand Canyon National Park, Grand Canyon	506	—	Grand Canyon Region (Coconino Co., Ariz.)	All local genera	Photographs, slides & kodachromes
Museum of Northern Arizona, Box 601, Flagstaff	761	—	Northern Arizona	—	—
University of Arizona Dept. of Entomology & Economic Zoology, Tucson	750	—	Ariz.	Dipodomys, Neotoma, Perognathus, Peromyscus	Photographs, slides, kodachromes & movies
Watkins, Allan G., Wallace Ranger Station, Winslow	144	—	Miss. & Tex.; a few from Fla., Ala., La., N. Mex., Ariz.	—	Most of his study skins have been given to institutions Kodachromes
Arkansas					
University of Arkansas Museum, Fayetteville	200	—	Ark. & Ozarks	Peromyscus from Arkansas Valley	—

California					
California Academy of Sciences, San Francisco	9000	9	Calif., Idaho, Ariz., B. C., Alaska, Lower Calif., Galapagos Is.	Pinnipeds	Several hundred mounted specimens—not included in 9000 listed. Photographs, slides, kodachromes & movies
California Forest & Range Experiment Station, Berkeley	250	—	Calif.	—	Includes most of mammal species occurring on the San Joaquin Experimental Range
Chico State College, Chico	500	—	Calif.	—	Photographs, kodachromes & movies
Constantine, Denny G., General Delivery, San Jose	58	—	Calif.	—	Former collection lost. 8 mm. kodachrome "shots" of bats, etc.
Couffer, Jack C., 1625 Country Club Drive, Glendale	300	—	Calif.	—	—
Dalquest, Walter W., Museum of Vertebrate Zoology, Berkeley	2500	—	Wash.	Neürotrichus	Mostly small mammals, collected to show distribution & variation in relation to continental glaciation
* D. R. Dickey Collection, Univ., of Calif., at Los Angeles, Los Angeles	20000	—	Western U.S.A.; Salvador	—	Now the property of the Univ. of Calif. at Los Angeles
Ellis, Ralph, 2420 Ridge Road, Berkeley	5000	2	Calif., Idaho, Wash., Ariz., & Nev.	—	Photographs & Slides
Fresno State College, Fresno	500	—	Fresno Co., Calif.	Dipodomys n. exilis	—
Hawbecker, Albert C., Soil Conservation Service, Watsonville	71	—	Calif.	Citellus nelsoni	—
Hildebrand, Milton, 500 Coventry Rd., Berkeley	500	—	Calif.; Salvador	—	Mostly skeletal material
Huey, Laurence M., Natural History Museum, Balboa Park, San Diego	1026	—	—	—	Photographs & slides
Keene, Herman, Santa Paula	—	—	—	—	Small private collection. Questionnaire not answered. Information from other sources.

* Deceased

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
Lassen Volcanic National Park, Mineral	33	—	Lassen Volcanic National Park	—	Slides, kodachromes & movies
Lindeborg, Robert G., Tecate	—	—	—	—	No personal collection. Specimens placed in museums.
Lindsey, Alton G., Univ. of Redlands, Redlands	—	—	—	—	Photographs of Weddell seals in Bay of Whales, Antarctica. 2 reels (16 mm. & 35 mm.) of Weddell seal's life history.
Linsdale, Jean M., Jamesburg Route, Monterey	700	—	Hastings Reservation, Monterey Co., Calif.	Peromyscus, Citellus	—
Little, Luther, 2305 Brentford Road, San Marino	1225	—	Calif.	Chiroptera	Specializes in bats of the world
Littlejohn, Chase, 323 E. Brewster Ave., Redwood City	400	—	Calif.; a few from other states & Canada	Sciuridae	Early collection in Balboa Park Museum, San Diego
Los Angeles City College, 855 N. Vermont Avenue, Los Angeles	412	—	Chiefly southern Calif.	—	A teaching collection. Slides & kodachromes—mostly copies of illustrations
Los Angeles Museum, Exposition Park, Los Angeles	9000	8	Calif., Ariz., Colo., N. Mex., Tex.	Dipodomys, Perognathus, Thomomys	150 mounted skeletons
Loukashkin, Anatole S., 1565 Scott St., San Francisco	500	1	Manchuria (northern part), China, eastern Asia	—	Photographs & slides—album of burrow drawings
Nichols, Walter F., 120 S. San Rafael Ave., Pasadena	—	—	—	—	Small personal collection—no detailed information given.
Pacific Union College, Angwin	500	—	Calif., Nev.	—	A teaching collection. Photographs & movies
Sacramento Junior College, Sacramento	214	—	Central Calif.	—	—

San Bernandino Junior College, San Bernardino	350	—	San Bernardino Co., Calif.	Rodentia	—
San Diego Society of Natural History, Balboa Park, San Diego	13477	46	Ariz. & Lower Calif.; also southern Calif. & northern Sonora, Mexico	Thomomys, Perognathus Dipodomys	—
San Francisco State College, Science Dept., Haight & Buchanan St., San Francisco	300	—	Calif.	—	Photographs & slides.
San Jose State College, San Jose	100	—	Calif.	—	Photographs
Santa Barbara Museum of Natural History, Santa Barbara	650	—	Calif.	—	About 800 ft. of 16 mm. film on local small mammals.
Santa Monica Junior College, Dept. Zoology, Santa Monica	250	—	Calif.	—	Some mounted specimens. Part of collection belongs to J. Stanley Brode. Slides & kodachromes
* Silliman, O. P., 225 West Alisal St., Salinas	2500	—	Calif.	Myotis, Eptesicus, Dipodomys	Numerous paratypes & topotypes.
Stager, Kenneth E., Los Angeles Museum, Los Angeles	1000	—	Calif., Nev., Ore., Ariz., Colo., Mont., Okla., Tex. N. Mex., La., Fla., S. C., Pa., Ga.; Mexico (Lower Calif.)	Chiroptera	Stored at Los Angeles Museum.
University of California, College of Agriculture, Div. of Zool., Davis	500	—	North central Calif.	Odocoileus, Thomomys	A teaching collection. Slides & photographs.
University of California at Los Angeles, Los Angeles	500	—	South America, Africa, Australia	Pleistocene genera—Smilodon, Aenocyon, Mylodon, Bison, Equus, Canis, Felis.	Teaching collection for comparative osteology & vertebrate paleontology. D. R. Dickey collection stored here.

* Deceased

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
UNITED STATES—*Continued*					
University of California, Museum of Vertebrate Zoology, Berkeley	100,027	296	Pacific Coast, from Alaska, to Lower Calif., Great Basin, northern Mexico & Salvador	Scapanus, Neürotrichus, Sorex, Myotis, Ursus, Mustela, Citellus, Eutamias, Thomomys, Perognathus, Dipodomys, Microdipodops, Onychomys, Peromyscus, Neotoma, Lemmiscus, Microtus, Aplodontia, Ochotona	312 mammals in addition to those listed, available for exchange. 2832 catalogued photographs & 480 slides
University of Southern California, Allan Hancock Foundation, University Park, Los Angeles	2000	—	Ariz., Calif., Colo., Ky., Mass., Mich., Ohio, Ore., Tex., Wis., Wyo.; Ontario; Costa Rica, Panama, Lower Calif., Sonora, Colombia	Pizonyx	Material obtained chiefly in the course of 10 expeditions to Mexico, Central & South America. Photographs, kodachromes & movies, mostly of marine mammals
von Bloeker, Jack C., Jr., 440 West 52nd Place, Los Angeles	3000	—	Calif., Ore., Wis., N. Y., S. C., Colo., Lower Calif.	Sorex, Dipodomys, Perognathus, Peromyscus, Neotoma, Microtus	Photographs
Yosemite National Park, U. S. National Park Service, Yosemite	824	—	Yosemite National Park	—	Slides & kodachromes.
Colorado					
Colorado College, The Museum, Colorado Springs	65±	—	—	—	Mounted specimens. Photographs. E. R. Warren collection stored here

Colorado Museum of Natural History, Denver	4000	—	Colo., Alaska; South America	—	Photographs, slides, kodachromes & movies.
Colorado State College, Dept. of Zool., Fort Collins	—	—	Colo.	—	A few study skins & mounted specimens.
Colorado State College of Education, Dept. of Zool., Greeley	500±	—	Colo. & vicinity	—	Mounted specimens
Rocky Mountain National Park (Moraine Museum), Estes Park	100	—	Rocky Mountain National Park	Castor	38 mounted specimens. Photographs, slides, kodachromes & movies.
University of Colorado Museum, Boulder	1340	—	Colo.	Felis	89 mounted specimens. Slides.
* Warren, Edward Royal, Colorado Springs	4500		Colo.	Peromyscus, Eutamias	Photographs. Collection now at Colorado College, Colorado Springs.
Connecticut					
Children's Museum, Hartford	14	—	Conn.	—	Mounted specimens
Peabody Museum of Natural History, Yale University, New Haven	1500	—	Conn., N. Mex.; Ecuador; Kenya Colony (Africa)	—	About 500 are mounted specimens. Photographs & slides
Trinity College, Hartford	81	—	U.S.A.; Canada; Australia; India	Equus (evolution series)	Photographs & slides
University of Connecticut, Storrs	75	—	New England States	—	Mostly mounted material
Wesleyan University, Geology Department, Middletown	690	—	New England, Ariz., Colo.; Alaska; Costa Rica; Australia.	Mus, Sciurus	—
Yale School of Forestry, New Haven	—	—	—	—	No mammal specimens. 5400 slides, 200 reels of motion picture film (about half being pictures of North American mammals). Known as the "Frank Richards Oastler Collection."

* Deceased

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
District of Columbia					
Biological Surveys Mammal Collection, Washington	138,130	1331	North & Middle America, West Indies.	—	See note 1 at end of list.
Howard University, Dept. of Anatomy, Washington	—	—	—	—	No mammal specimens. Slides of occlusal views of dentitions of representative members of all mammalian groups; showing characters of craniofacial union.
U. S. Department of the interior, Section on National Park Wildlife	100	—	Sequoia National Park, Calif.; Crater Lake National Park, Ore.	Eutamias, Zapus, Peromyscus	Collection housed at Museum of Vertebrate Zoology, Univ. of Calif. About 5000 mammal negatives dealing with life history & wildlife management. Negatives housed in Section on National Park Wildlife, San Francisco, California.
United States National Museum, Washington	97,086	1503	Malay region; East Africa; Western Europe; Australia; northern & western China; eastern North America	—	Photographs. See note 1 at end of list.
Delaware					
Delaware State Board, Game & Fish Commission, Dover.	—	—	New Castle, Kent, Sussex counties, Del.	—	Primarily a teaching collection, Photographs, slides, kodachromes & movies.

Florida					
Bailey Collection & Library of Natural History, 820 Alhambra Circle, Coral Gables	3050	3	U.S.A.; Canada	Sciurus, Lepus, Felis, Thomomys	Collection is being moved to new quarters in Virginia.
Barrington, B. A., Jr., Keystone Heights	70	—	Fla.	—	—
Florida State Museum, Gainesville	460	—	Fla.	Rodentia	
Moore, Joseph C., Dept. of Biology, University of Florida, Gainesville	181	—	Alachua & Putnam counties, Fla.	—	—
Patton, Clyde P., 326th Bomb. Sqdn., Sarasota	—	—	—	—	No private collection. Has donated specimens to various institutions.
Sherman, H. B., Box 2049, University Station P. O., Gainesville	2400	1	Fla.	Geomys, Tadarida, Myotis	Photographs & slides.
Yale Laboratories of Primate Biology, Orange Park	12	—	—	Embalmed Chimpanzees. All except dwarf species represented.	Photographs extensive. Some movies.
Spencer, H. J., 834 N. Roper Ave., Gainesville	—	—	Colo., Tex., N. Mex., Ariz., Ill., Ind., Va., New England, Fla.; Hawaii & Wake Is. (Pacific Ocean)	Rodentia	"Several hundred study skins. The Spencer Mammal Collection is somewhat of a family affair." (See Donald A. Spencer, N. Y.) Collection housed at 3245 Perry St., Denver, Colo.
Georgia					
Barkalow, Frederick S., Jr., 207 Washington Ave., Marietta	200	—	Ala.	—	Bulk of collection deposited in Museum of Zoology, Univ. Mich. Photographs, slides & kodachromes

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
UNITED STATES—*Continued*					
Komarek, E. V., Coöperative Quail Study, Thomasville	50	—	Ga., Fla.	—	Photographs.
Wood, J. E., Marietta	70	—	Northern Ga.	—	Questionnaire not answered—information from other sources.
Idaho					
Arvey, M. Dale, Boise Junior College, Boise	72	—	Idaho	—	—
University of Idaho, Dept. of Zool., Moscow	240	—	Northern Idaho	Peromyscus	Teaching collection.
Whitlow, Wayne B., Pocatello High School, Pocatello	250	—	Idaho	—	Small part of larger collection, stored at Museum of Vertebrate Zoology. Berkeley. Part of collection belongs to Pocatello High School.
Illinois					
Adams, L. A., 439 Natural History Building, Urbana	1500	—	U.S.A.; Australia; Malay	—	Mostly mounted specimens & skeletons. Photographs & slides.
Chicago Academy of Sciences, Lincoln Park at Clark & Ogden Aves., Chicago	4500	4	Tenn., N. C., (especially great Smoky Mts.), Fla., Ill., Ind., S. Dak., Wyo., Ariz.	—	Movies.
Chicago Natural History Museum, Chicago	50,000	260	North America; South America; Africa; China; Indo-China	—	883 mounted mammals. Photographs & slides.

Fautin, Reed W., 1213 Clover Ave., Rockford	80	—	Utah, Ill.	—	—
Gregory, Tappan, 19 S. LaSalle St., Chicago	200	—	Ill.	—	Excellent photographs & slides.
Illinois Natural History Survey, Urbana	720	—	Ill.	—	Slides.
Koestner, E. J., Piper City	300	—	Ill.	—	—
Northwestern University, Dept. of Zool., Evanston	657	—	Ky. Tenn., Ill., Ind., Colo., Idaho	—	A teaching collection
Southern Illinois Normal University Museum, Carbondale	100	—	20 southern counties of Ill.	Myotis	—
Indiana					
Earlham College, Joseph Moore Museum, Earlham	18	—	—	—	Photographs, slides & movies
Evansville College, Evansville	25	—	Middle western states	—	Mostly mounted specimens. Photographs
Northern Indiana Historical Society, 112 S. Lafayette Blvd., South Bend	30	—	Ind.	—	Mounted specimens. Some fossil material.
University of Notre Dame, Notre Dame	172	—	Ind., Wis.	Peromyscus	—
Iowa					
Davenport Public Museum, 704 Brady St., Davenport	500	—	Iowa	Ungulates	Most specimens without data. Approximately 40 mounted. Slides.
Hoslett, Sherman A., Biol. Dept. Luther College, Decorah	—	—	—	—	Collection lost by fire, May, 1942. Remnants in Museum of Zoology, Univ. of Mich. Plans to rebuild collection.
Iowa State College, Dept. of Zoology-Entomology, Ames	1400	—	Iowa; Canada; Mexico; South America; Africa; Australia.	—	80 mounted specimens. 600 photographs.

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
State Department of History & Archives, Des Moines	100	—	Iowa	—	Photographs, kodachromes & movies.
State University of Iowa, Museum Dept., Iowa City	—	—	Iowa	—	Questionnaire not answered—information from other sources.
Kansas					
Bethel College, North Newton	70	—	S. Dak., Kans.	—	Mounted specimens. Photographs.
Ft. Hays Kansas State College, Hays	150	—	Kans.	—	All mounted. Slides.
Kansas State College, Manhatten	300	—	Kans.	—	Approximately 100 mounted specimens.
Rinker, G. C., Hamilton, Greenwood Co.	1500	—	U.S.A.	Peromyscus	400 mounted specimens.
University of Kansas, Museum of Natural History, Lawrence	14,098	4	Kans., Ariz., central states	Peromyscus, Microtus, Neotoma, Marmota, Geomys, Dipodomys	Photographic collection personal property of Mr. C. D. Bunker.
Kentucky					
Barbour, Roger W., Science Hall	—	—	—	—	Photographs.
Morehead State Teachers College, Morehead	400	—	Eastern Ky.	Peromyscus	Teaching collection.
Western Kentucky State Teachers College, Bowling Green	15±	—	Ky.	—	Mounted specimens.
Louisiana					
Louisiana State University, Museum of Zool., Baton Rouge	2000	1	La. & other southern states, Calif.; Mexico	Peromyscus	—

Tulane University, New Orleans	405	—	North America	—	9 Platypus.
Maine					
Copeland, Manton, Bowdoin College, Brunswick	800	1	New England states	Peromyscus, Sorex	—
Lee Museum of Biology, Bowdoin College, Brunswick	300	—	New England states	Peromyscus, Sorex	—
Maine Coöperative Wildlife Research Unit, University of Maine, Orono	50	—	Maine	Microtus, Peromyscus, Blarina	Film on life history of snowshoe hare.
Portland Society of Natural History, Portland	—	—	—	—	Questionnaire not answered—information from other sources.
Maryland					
Hampe, Irving E., 5559 Ashbourne Rd., Halethorpe	160	—	Md. (Baltimore & vicinity)	—	Photographs.
Johns Hopkins University, Dept. of Anatomy, Medical School, Baltimore	—	—	—	Primates	Extensive collection of osteological & injected material. Questionnaire not answered—information from other sources.
Llewellyn, Leonard M., Patuxent Research Refuge, Bowie	300	—	Md., Va., W. Va.	—	—
Natural History Society of Maryland, 2103 N. Bolton St., Baltimore	116	—	Md.	—	Photographs & slides.
Patuxent Laboratory of Section of Food Habits, Patuxent Research Refuge, Bowie	763	—	U.S.A.	—	—
Vincent, John M., 3303 Westerwald Ave., Baltimore	125	—	Baltimore Co., Md.	Peromyscus, Microtus, Blarina, Sorex	—
Young, Stanley P., 5202 Murray Rd., Chevy Chase	50	—	Western & southern states; Alaska	Canis lupus	Photographs & slides

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
Massachusetts					
Austin Ornithological Research Station, North Eastham, Cape Cod	—	—	Cape Cod, Mass.	—	—
Berkshire Museum, Pittsfield	—	—	Berkshire Co., Mass.	—	—
Museum of Comparative Zoology, Cambridge	52,000	480	World-wide representation, except for Europe	—	Photographs. See note 2 at end of list.
Museum of Natural History, Springfield	278	—	Western & central Mass.	Zapus, Sciurus, Sorex	162 mounted specimens. Photographs & slides.
New England Museum of Natural History, 234 Berkeley St., Boston	1,249	—	New England States	Peromyscus, Clethrionomys.	Some mounted specimens.
Peabody Museum of Salem, Salem	400	—	Essex Co., Mass.; Africa; Australia.	—	—
Worcester Natural History Society, 12 State St., Worcester.	300	—	—	—	235 mounted specimens. Photographs, slides & kodachromes.
Michigan					
Cranbrook Institute of Science, Bloomfield Hills	100	—	Mich.	—	Major part of collection (not included here) is incorporated with the Univ. Mich. collection. Photographs & slides.
Central Michigan College of Education, Biology Dept., Mount Pleasant	90	—	Isabella Co., Mich.	—	Primary aim is to build up a collection from Isabella & surrounding counties, Michigan.

Clinkston, P. & R. S. Campbell, Central Michigan College, Mount Pleasant	100±	—	Mich. (Lower Peninsula)	—	—
Department of Conservation, Game Division, Lansing	45±	—	Mich.	—	Photographs, slides, kodachromes & movies.
Grand Rapids Public Museum, Grand Rapids	175	—	Mich.	—	About one-half mounted. Photographs & slides.
Hamerstrom, Frederick & Frances, Edwin S. George Reserve, Pinckney	100±	—	Iowa, Wis., Mich.	—	—
W. K. Kellogg Bird Sanctuary, (Branch of Mich. State College) Battle Creek	25	—	Mich.	—	Photographs & kodachromes
Michigan State College, Zool. Dept., East Lansing	500	—	Mich.	—	—
Rose Lake Wildlife Experimental Station, of Mich. Game Division, R.D. #1, East Lansing	125	—	Clinton Co., Mich.	—	Photographs, kodachromes & movies.
Swan Creek Wildlife Experiment Station, Mich. Dept. Conservation, Allegan	100	—	Southwestern Mich.	Sciurus, Sylvilagus	Photographs & kodachromes.
Test, Frederick H., University of Michigan, Ann Arbor	50	—	Calif., Ind.	—	Photographs.
University of Michigan, Dept. of Zool., Ann Arbor	200	—	Mich.	—	A few mounted specimens. Photographs, slides & movies.
University of Michigan, Laboratory of Vertebrate Biology, Ann Arbor	20000±	—	U.S.A.; Canada; Mexico	Peromyscus	Photographs & kodachromes. See note 3 at end of list.
University of Michigan, Museum of Paleontology, Ann Arbor	1,000	—	—	—	Synoptic collection of recent skulls & skeletons. Pathological teeth a specialty.

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
Michigan					
University of Michigan, Museum of Zoology, Ann Arbor	40,000	62	U.S.A.; Canada; Mexico; Central America, South America (Ecuador); India	Sciuridae, Leporidae	Collection contains an unusually fine series (2000–3000) of penis bones. Practically all U.S. genera which have the bone are represented. Photographs & kodachromes. See note 3 at end of list.
Minnesota					
Minneapolis Public Library Science Museum, 10th Hennepin, Minneapolis	50	—	Minn.; Africa	—	Mostly mounted specimens. 200 photographs & 650 slides.
Minnesota Museum of Natural History, Univ. of Minnesota, Minneapolis	1870	—	Minn., Mont.; Churchill, Manitoba.	Peromyscus	34 habitat groups. Photographs, slides & kodachromes.
Pettingill, O. S., Jr., Carleton College, Northfield	—	—	—	—	Photographs & movies.
State Teachers College, Bemidji	40	—	Northern Minn.		Mounted specimens. Teaching collection.
State Teachers College, Duluth	45	—	Minn.	—	Mostly mounted specimens.
U. S. Fish & Wildlife Service, University Farm, St. Paul	180	—	Minn., N. Dak.	Clethrionomys, Peromyscus, Microtus, Zapus, Eutamias.	Photographs & slides.
University of Minnesota, Division of Entomology & Economic Zoology, University Farm, St. Paul	1,000	—	Minn.	—	Teaching collection, Photographs, slides & kodachromes.

Mississippi					
Mississippi State College, State College	100	—	Miss.	—	—
State Game & Fish Commission, 2550 N. State, Pearl & Congress Sts., Jackson	5,966	—	Miss.	Peromyscus, Sigmodon, Mus, Rattus, Tamias, Sciurus, Reithrodontomys, Pitymys	Photographs, slides & movies.
Missouri					
Coöperative Wildlife Research Unit, Univ. of Missouri, Zool. Dept., Columbia	1,500	—	Mo.	Ondatra, Microtus, Peromyscus, Canis	Photographs, slides & kodachromes.
Montana					
Lambert, Henry, Sr., R.F.D., Livingston	7	—	Mont.	—	All mounted heads of Cervus & Alces.
Montana State College, Dept. Zool. & Ent., Boseman	500±	—	Mont., Wyo.	Citellus, Eutamias, Microtus.	—
Montana State University, Dept. Zool., Missoula	200	—	Mont.	Mustela	—
Wright, Philip L., Montana State University, Missoula	100	—	N. H., Wis.	—	—
Nebraska					
University of Nebraska, Dept. Zool., Lincoln	300+	—	Nebr.	Citellus	—
University of Nebraska, State Museum, Lincoln	1,360	—	Nebr.	Peromyscus, Microtus, Geomys, Canis, Ondatra, Lepus.	Private collection of the late M. H. Swenk housed here. Types from that collection in Mus. Vert. Zool., Berkeley, Calif.
Valentine National Wildlife Refuge, Valentine	—	—	—	—	Kodachromes

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
Nevada					
Alcorn, J. R., Fallon	604	—	Nev.	—	—
University of Nevada, Dept. Biol., Reno	60	—	Nev. & adjacent Calif.	—	Mostly mounted specimens. Photographs & slides.
New Hampshire					
Annie E. Woodman Institute, 182-192 Central Ave., Dover	100	—	New England	—	Mostly mounted specimens.
Dartmouth College Museum, Hanover	900	—	N. H., Vt., Adirondacks of N. Y.; Quebec.	—	About 150 mounted specimens.
Jackson, C. F., University of New Hampshire, Durham	450	1	N. H.; North Shore of the Gulf of St. Lawrence.	Sorex	Part of the collection is the property of the University. Photographs, slides, kodachromes & movies.
New Jersey					
Carter, T. Donald, R.D. #2, Boonton	500	—	Eastern North America—chiefly N. Y. city region, New England & N. J., some from Fla. & N. C.	Sciuridae	—
The Newark Museum, Newark	350	—	Eastern North America; Africa.	—	Mostly mounted specimens
Peterson, Russell G., 42 Overlook Road, Verona	200	—	Eastern seaboard of U.S.A.	Napaeozapus, Zapus, Myotis.	Mostly mounted specimens
Storer, Robert W., 522 Vose Avenue, South Orange	200	—	N. J., Calif.; Mexico	Chiroptera	Bulk of collection on loan to Princeton Museum of Zoology.

New Mexico					
National Park Service, No. 5 Office of Interpretation, Coolidge	150	—	Otero Co., N. Mex.	—	Photographs, kodachromes & movies.
State College, Biology Dept., State College	150	1	N. Mex.	Dipodomys, Thomomys, Citellus	Collected during New Mexico Natural History Survey, 1900–1910.
University of New Mexico, Albuquerque	60	—	Central N. Mex.	—	A teaching collection.
New York					
American Museum of Natural History, New York City	125,358	838	North America; South America; Asia; Africa; Madagascar, Australia; Oceanica.	Rodentia, Chiroptera	1450 mounted specimens. Photographs, slides, kodachromes & movies. See note 4 at end of list.
Brooklyn Children's Museum, Brooklyn Ave. & Park Place, Brooklyn	—	—	Northeastern U.S.A.	—	A teaching collection of mounted specimens. Slides & movies.
Cornell University, Ithaca	3,500	—	N. Y., New England states, Va., Calif., Ore., Colo.; Canada.	—	70 mounted specimens. About 400 slides.
Latham, Roy, Orient, Long Island	200	—	N. Y.	—	25 mounted specimens. Photographs.
New York State Conservation Dept., Albany	300	—	Green & Albany cos., N.Y.	Mustela, Mephitis, Vulpes, Urocyon, Ondatra.	Kodachromes
New York State Conservation Dept., Bureau of Game, Food Habits Research Laboratory, Albany	200	—	N. Y.	—	Collection used for comparative work in Food Habits Laboratory
New York State Museum, Albany	1,165	—	N. Y.	Peromyscus, Zapus, Sciurus, Napaeozapus, Marmota, Microtus, Clethrionomys.	—
New York Zoological Society, Bronx Zoo, New York City	—	—	—	—	5000 photographs, 300 slides, 50 kodachromes & 10,000 ft. of movies.

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
New York (Continued)					
Palmer, R. S., Vassar College, Dept. Zool., Poughkeepsie	500	—	Maine	—	Photographs & kodachromes
Roosevelt Wildlife Station, N. Y. State College of Forestry, Syracuse	700	—	N. Y.	Microtus Peromyscus, Sciurus, Blarina, Eutamias.	Photographs
Smiley, Daniel, Jr., Mohonk Lake, Ulster Co.	100	—	Ulster Co., N. Y.; Delaware Co., Pa.; Houston Co., Ala.	—	—
Spencer, Donald A., R.D. #1, Rochdale Rd., Poughkeepsie	1,400	—	Tex., Ariz., Colo., N. Mex., N. Dak., Va., New England states.	Geomys, Thomomys	Kodachromes & movies of small mammals of north-eastern U.S.A.—especially Canadian porcupine. See Spencer, H. J., Florida.
Trapido, Harold, Stimson Hall, Cornell University, Ithaca	75	—	N. Y., Pa., N. J., Va.	Myotis	Chiroptera only.
University of Buffalo, Biology Dept., Buffalo	187	—	Western N. Y.	—	Part of collection belongs to A. R. Shadle. Photographs, slides & movies.
University of Rochester, Biological Laboratories, Rochester	400±	—	N. Y.; South & Central Americas; Africa; Australia.	—	Some mounted material.
Webb, J. Watson, Westbury, Long Island	—	—	North America	—	Reported to have fine collection of big game heads; also fine motion pictures of Dall's Mountain Sheep. Questionnaire not answered—information from other sources.
North Carolina					

North Carolina					
Division of Game and Inland Fisheries, 209 New State Office Bldg., Raleigh	—	—	—	—	Photographs
North Carolina State Museum, Raleigh	300	—	N. C.	Cetacea	100 mounted specimens. Photographs
North Dakota					
Allen, J. D., 302 Fifth Avenue, Nandan	36±	—	—	—	Mounted North American big game heads & antlers. Some for sale.
North Dakota Agricultural College, Dept. Zool., Fargo	160	—	N. Dak. & environs	Rodentia	Mostly historic material used by Vernon Bailey in preparing North American Fauna #49.
University of North Dakota, Dept. Biol., Grand Forks	114	—	N. Dak.	—	A teaching collection. Photographs, kodachromes & movies.
Williams, W. H., Grafton	—	—	N. Dak.	—	Principally mounted specimens. Has a few study skins for sale.
Ohio					
Bowling Green University, Bowling Green	200	—	Ohio	—	Approximately 60 mounted specimens.
The Cleveland Museum of Natural History, 2717 Euclid Ave., Cleveland	18,200	50±	Ohio, Ore., Eastern Calif., Ariz.; East Africa	Citellus, Eutamias, Cynomys, Tamias, Blarina, Sorex, Microtus, Peromyscus.	Photographs & slides of local mammals.
College of Wooster, Wooster	150	—	Ohio	—	Slides.
Goodpaster, Woodrow, Museum of Natural History, Parkway & Walnut St., Cincinnati	1,500	—	Ohio, Ky., Tex., Calif., Vt., Ill., Fla., Mont., Wyo., Ga.	—	Collection stored in Cincinnati Museum.
Goslin, Robert M., 316 Wilson Ave., Columbus	—	—	Ohio, Ind., Ky., Tenn.	Mice & bats	Entire collection (639 specimens) donated to various museums. About 50 photographs & 20 slides.
Hamann Museum of Human Anatomy & Comparative Anthropology, Dept. of Anatomy, School of Medicine, Western Reserve University, Cleveland	2,900	—	Africa; Asia; Australia.	Primates	An excellent collection of osteological material.

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
UNITED STATES—*Continued*					
Ohio (Continued)					
Ohio State Museum, Columbus	1,319	—	Ohio	—	About 200 mounted specimens. Approximately 200 slides; 200 additional slides in personal collection of E. S. Thomas.
Ohio University, Dept. of Zoology, Athens	500	—	Southeastern Ohio	—	Movies.
Ohio Wildlife Research Station, Ohio State University, Columbus	800	—	Ohio, Ky., far western states.	Sciurus, Vulpes, Urocyon, Didelphis, Mustela	Collection belongs, in part, to University, and in part to Laurence E. Hicks. Photographs, slides & kodachromes.
Public Library Museum, 251 E. 2nd St., Dayton	100	—	Montgomery Co., Ohio	—	Kodachromes.
Oklahoma					
Oklahoma Agricultural & Mechanical College, Zool. Dept., Stillwater	407	—	Payne Co., Okla.	Peromyscus	—
University of Oklahoma, Museum of Zoology, Norman	1,120	1	Okla., Colo.	Peromyscus	A few mounted specimens. Topotypes of *Dipodomys oklahomae*.
Whitaker, H. L., SCS, Vinita	150	—	Okla.	Peromyscus	Most of collection in Oklahoma University Museum.
Oregon					
Broadbrooks, Harold E., Newport	223	—	Nev., Wash.	—	Photographs.
Dirks, J. Claire, Linfield College, McMinnville	100	—	Ore., Wash., Ill.	—	Stored at Linfield College temporarily.

Jewett, Stanley G., 1404 Bidwell St., S. E., Portland	3,230	1	Wash., Ore., Calif.	Phenacomys, Mustela, Ochotona, Thomomys.	—
Macnab, Jas. A., Linfield College, McMinnville	50	—	—	—	Questionnaire not answered—information from other sources.
Moore, A. W., Fish & Wildlife Service, 673 E. Main St., Hillsboro	—	—	—	—	Photographs of Pacific northwest mammals. Kodachromes showing range-rodent relationships. All mammal specimens sent to U. S. National Museum, Washington, D. C.
Oregon State Game Commission, 616 Oregon Bldg., Portland	850	—	Ore.	—	About 30 mounted specimens.
Walker, Alex., Route 1, Box 267, Tillamook	625	—	Ore., Ariz.	Sciurus, Thomomys	Has collected about 2000 mammal specimens. Will Exchange. Photographs, slides & kodachromes.
Walker, Kenneth M., Route 1, Box 267, Tillamook	140	—	—	—	—
Pennsylvania					
The Academy of Natural Sciences of Philadelphia, 19th & the Parkway, Phila.	22,000	156	North America; Africa	—	Much historical material from the eastern U. S. A. Photographs, slides, kodachromes & movies.
Allegheny College, Meadville	6	—	Northwestern Pa.	—	Mounted specimens.
Carnegie Museum, Pittsburgh	21,500	23	Utah, western Pa.; northern Quebec; West Africa; South America.	Dicrostonyx, Lemmus, Peromyscus, Eutamias, Alopex, African Bovidae	About 250 mounted specimens. Photographs, slides, kodachromes & movies of mammals & mammalian habitats.
Carpenter, C. R., State College, State College	—	—	—	—	Colored slides of monkeys & gibbons. Film on characteristics of gibbon & rhesus monkey behavior.

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
Pennsylvania (Continued)					
Enders, Robert K., Swarthmore College, Swarthmore	100	—	Canal Zone; Australia	Marsupials, endentates, primates.	All specimens sent to Academy of Natural Sciences of Philadelphia. Photographs, slides, kodachromes & movies.
Haverford College, Haverford	100	—	Pa.	—	—
Pennsylvania State College, Dept. of Zool., State College	324	—	Pa.	Sylvilagus, Marmota, Peromyscus, Sciurus, Mustela.	—
Reading Public Museum & Art Gallery, Reading	3,000	—	Eastern & central Pa.	Chiroptera	100 mounted specimens. Photographs, slides & movies.
St. Vincent College, Latrobe	50	—	Pa.	—	All mounted
Waynesburg College, Waynesburg	610	—	Greene Co., Pa.	Synaptomys	About 40 specimens of African big game heads. Photographs & slides.
South Carolina					
Coleman, Robert H., Route 4, Box 212, Charleston	1,369	—	S. C., Nebr.	—	—
South Dakota					
Dakota Wesleyan University, Mitchell	6	—	S. Dak.	—	4 mounted skeletons. 200-300 slides.
University of South Dakota, Vermillion	100	—	S. Dak.; Australia	—	Mostly mounted specimens. Photographs, slides & movies.
Tennessee					
Great Smoky Mountains National Park, Gatlinburg	250	—	Eastern Tenn., western N. C.	—	—

Texas					
Davis, W. B., College Station	300	—	Western states; Africa; Asia	—	Teaching collection.
Dallas Museum of Natural History, Dallas	250	—	Tex.; Coahuilla, Mexico.	—	50 mounted specimens. Photographs.
Kirn, Albert J., P. O. Box 157, Somerset	225	—	Kans., Tex.	—	—
Texas Coöperative Wildlife Collection, College Station	3,000	11	Tex.; Mexico.	Geomys, Sciurus, Peromyscus, Baiomys, Neotomodon, various bats.	—
Texas Game, Fish & Oyster Commission, Austin	35±	—	Tex.	—	Photographs & movies.
West Texas State College, Canyon	—	—	Southwestern U.S.A.	—	No mammalogist in charge. Collection in bad condition.
Utah					
Brigham Young University, Provo	2,000	—	Utah	—	—
Dixie Junior College, Saint George	200±	—	Southern Utah	—	—
Hardy, Ross, Dixie Junior College, Saint George	600	—	Southern Utah	Peromyscus, Eutamias, Antrozous, Corynorhinus	—
University of Utah, Museum of Zoology, Salt Lake City	4,000	7	Utah	Citellus, Thomomys, Dipodomys, Microdipodops, Perognathus, Peromyscus, Reithrodontomys, Onychomys, Neotoma, Lepus, Sylvilagus.	—
Utah State Agricultural College, Logan	1,100	—	Utah	Eutamias, Peromyscus.	Kodachromes.
Vermont					
The Fairbanks Museum of Natural Sciences, St. Johnsburg	84	—	Vt., Maine; Nova Scotia; Australia; South America.	—	Horns, heads, skeletons & mounted specimens— no skins. Photographs, slides & movies.

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
Vermont (Continued)					
Fleming Museum, University of Vermont, Burlington	200	—	Vt.	Peromyscus	A few African horns.
Kent, Duane E., 39 Morse Place, Rutland	225	—	Vt.	Moles, shrews, bats, Peromyscus.	—
Kirk, George L., 8 East Washington St., Rutland	400	—	Vt.	Peromyscus, Clethrionomys, Sorex.	—
Osgood, Frederick L., Jr., 17 Charles St., Rutland	800	—	Vt.	Peromyscus, Myotis, Pipistrellus, Microtus, Clethrionomys.	—
Schaldach, William J., Jr., "Slantways," West Hartford	93	—	Vt.	—	—
Vermont Fish and Game Service, 89 State St., Montpelier	150	—	Vt.	—	—
Virginia					
Handley, C. O., Jr., Virginia Polytechnic Institute, Blacksburg	115	—	Western Va.	Pipistrellus, Reithrodontomys, Microtus, Blarina, Peromyscus.	—
The Seward Forest, Triplett	170	—	Amelia & Brunswick cos., Va.	Peromyscus, Blarina, Reithrodontomys.	Specimens are divided between the University of Virginia & the Seward Forest collections.
University of Richmond, Richmond	200	—	Va.	—	150 slides.
University of Virginia, Charlottesville	—	—	—	—	Mounted specimens from Africa & Asia. Horns of elk & moose collected by Lewis & Clark Expedition; sent by Lewis to Thomas Jefferson.

Virginia Polytechnic Institute, Blacksburg	600	—	Va.	Peromyscus, Sylvilagus	—
Washington					
Booth, Elwood R., College Place	115	—	Ore., Wash.	—	Photographs, slides of parasitic worms, fleas & lice.
Booth, Ernest S., Dept. of Biol., Walla Walla College, College Place	1,000	—	Wash., Ore.	Microtus, Sorex.	Photographs, slides, kodachromes & movies.
Eastern Washington College of Education, Cheney	204	—	U.S.A.; Canada.	Citellus, Sciurus, Peromyscus, Microtus, Eutamias.	—
Eyerdam, Walter J., 7531 19th Ave., N.E., Seattle	71	—	U.S.S.R.	—	Many photographs of Alaskan animals, especially whales; also photographs of Patagonian mammals.
Leraas, Harold J., Pacific Luthern College, Parkland	180	—	Pierce & Thurston cos., Wash.	Peromyscus, Microtus, Sorex.	Specializes in Puget Sound area.
Mount Rainier National Park, Longmire	122	—	Mount Rainier National Park.	—	Some mounted specimens.
Oliver, John, Box 296, College Place	50	—	Wash., Ore., Idaho.	—	Collection now the property of Ernest S. Booth.
Scheffer, Victor B., 105 Anderson Hall, University of Washington, Seattle	400	—	Wash., Ore.; Alaska.	Callorhinus.	Specimens belong to Biological Surveys Mammal Collection, Washington, D. C. Photographs (200), slides (50), kodachromes (150), mainly of Alaskan mammals.
Slipp, John W., 1532 No. Anderson, Tacoma	100	—	Wash.	—	Photographs.
State College of Washington, Chas. R. Conner Museum, Pullman	1,500	—	Wash., & Pacific northwest	Peromyscus, Microtus, Eutamias, Tamiasciurus.	—

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			UNITED STATES—*Continued*		
Washington (Continued)					
Svihla, Arthur, Dept. of Zool., University of Washington, Seattle	100	—	La., N. Mex., Utah, Wyo., R. I., Mich., Ill., Wash.; Hawaii.	—	—
Underhill, R. A., College Place	100	—	Eastern Wash.	Microtus	Kodachromes.
University of Washington, Washington State Museum, Seattle	1,071	—	Wash.	Aplodontia, Eutamias, Sciurus, Sorex, Neürotrichus, Peromyscus.	24 mounted specimens. Some topotypes.
Wagner, Edward D., 709 N. Spring St., Pullman	200	—	Wash., Ore.	Sorex, Microtus, Citellus, Thomomys, Peromyscus	Photographs & kodachromes.
Walla Walla College Museum of Natural History, College Place	600	—	Wash., Ore., Ariz., Nev.	Microtus, Peromyscus, Thomomys	—
Whitman College, Walla Walla	200	—	Wash.	—	Questionnaire not answered—information from other sources.
West Virginia					
Frum, W. Gene, 425 High Street, Morgantown	75	—	W. Va.	—	—
Haller, Karl W., 6 Martindill Terrace, Wheeling	174	—	W. Va.	—	Collection stored at Carnegie Museum. Photographs & kodachromes.
Morgan, A. S., Winfield	100	—	W. Va., Ark., La.; Canada, Ontario.	—	Mounted specimens. Photographs.
West Virginia University, Morgantown	250±	—	W. Va.	—	Primarily a teaching collection.
Wilson, L. Wayne, Moorefield	61	—	W. Va.	—	—

Wisconsin					
Milwaukee Public Museum, 818 W. Wisconsin Ave., Milwaukee	4,055	—	Wis.; North America; British East Africa; Australia.	—	1100 photographs, 1250 slides & 30 reels of movies.
University of Wisconsin, Dept. of Wildlife Management, 424 University Farm Place, Madison	40	—	Wis.; Canada, Manitoba.	—	A teaching collection. Slides.
University of Wisconsin, Dept. of Zool., Madison	2,000	—	Wis., Colo.; Alaska.	—	—
Wyoming					
National Park Service, Yellowstone National Park	240	—	Yellowstone National Park	Peromyscus, Martes.	150 colored slides, 250 kodachromes, & about 4500 ft. of 16 mm. kodachrome movies.
University of Wyoming, Zoology Dept., Laramie	300	—	Wyo., Colo.	Peromyscus.	About 250 slides, kodachromes & 6 reels of 16 mm. movies.
CANADA					
Alberta					
Rowan, Wm., University of Alberta, Edmonton	500	—	World-wide.	Bison.	Primarily skulls & skeletons. Contains many rarities. Photographs & slides.
British Columbia					
Brooks, Allan Cecil, Jr., Okanagan Landing	300±	—	British Columbia.	Rodentia, Insectivora.	—
Domestic Livestock Insect Laboratory, Kamloops	150	—	British Columbia.	—	A growing collection, primarily for the study of host-parasite relationships.
Hatter, James, Lake Cowichan	42	—	British Columbia.	—	—
Munro, J. A., Okanagan Landing	818	1	British Columbia.	—	Photographs & movies.
Provincial Museum, Victoria	4,800	7	British Columbia.	Peromyscus, Martes, Sorex, Mustela, Canis, Microtus.	Photographs & slides.

List of Mammal Collections—Continued

NAME AND ADDRESS	TOTAL NUMBER OF SPECIMENS	NUMBER OF TYPE SPECIMENS	LOCALITIES BEST REPRESENTED	GROUPS ESPECIALLY WELL-REPRESENTED	REMARKS
			CANADA—*Continued*		
British Columbia (Continued)					
University of British Columbia, Dept. of Zoology, Vancouver	900	—	British Columbia.	—	Photographs taken in connection with specific life history & anatomical studies of large mammals.
Manitoba					
Criddle, Stuart, (Aweme) Treesbank	1,200	—	Southern Manitoba.	—	Extensive notes on specimens collected.
Manitoba Museum, Auditorium, Winnipeg	140	—	Manitoba.	—	A growing collection. Photographs & slides.
Soper, J. Dewey, 536 Dominion Public Bldg., Winnipeg	600	—	Manitoba, Saskatchewan, Alberta.	Tamiasciurus, Eutamias, Clethrionomys, Peromyscus, Microtus, Citellus, Thomomys, Zapus.	Photographs & slides.
Ontario					
Banfield, A. W. Frank, 932A Avenue Road, Toronto	300	—	Ontario, Saskatchewan.	Sorex.	—
Beare, George E., 108 Eastbourne Ave., Toronto	337	—	Vicinity of Toronto, Lake Erie & Kapuskasing.	—	Photographs.
Brown, N. Rae, 897 Dufferin Avenue, London	400	—	Renfrew Co., Ontario.	Myotis, Napaeozapus, Clethrionomys, Peromyscus, Sorex, Blarina, Tamias.	—
Davies, D. M., 59 Hillholme Road, Toronto	43	—	Algonquin Park & Turkey Point, Ontario	—	—
Hitchcock, Harold B., University of Western Ontario, London	150	—	Ky.; Ontario.	Myotis.	Photographs of bats and bat banding operations.

National Museum of Canada, Dept. of Mines & Resources, Ottawa	17,131	15	Canadian Provinces & Territories.	—	Photographs, slides, kodachromes & movies. See note 5 at end of list.
Queen's University, Dept. of Biology, Kingston	250	—	Ontario.	—	—
Royal Ontario Museum of Zoology, Toronto 5	13,000	1	Ontario.	—	About 300 mounted specimens. Photographs & slides.
* Saunders, W. E., 240 Central, London	900	—	Canada—Atlantic to Pacific.	Microtus, Peromyscus.	—
Thompson, Stuart L., 118 Bessboro Dr., Leaside, Toronto	72	—	U.S.A.; Canada.	Rodentia.	Photographs & slides.
Wood, A. A., 189 Adelaide St. S. Chatham	30	—	Ky.; Ontario.	—	Has sold practically all of the mammals he has collected.
University of Western Ontario, Zoology Dept., London	350	—	Ontario, Saskatchewan.	—	—
Saskatchewan					
Holmes, Chas. F., Dollard	25	—	Southwestern Saskatchewan.	—	—

* Deceased

It has been impossible to reply to all the letters and notes we have received in connection with this survey, but we wish to express our appreciation to all those persons who have cooperated with us in assembling these data. For some of the larger museums, several days of painstaking labor have been required to compile the information, and we are particularly grateful to those individuals who gave so unstintingly of their time. The Soil Conservation Service, the Fish and Wildlife Service and the Grinnell Naturalists Society, by publicizing the project, have assisted materially in obtaining information. We sincerely appreciate their assistance. We are also indebted to Dr. Andrey Avinoff, Director of the Carnegie Museum, for his encouragement and support throughout this project. Mr. Doutt's associate, Miss Caroline A. Heppenstall, has borne the brunt of the entire project, and has not only taken charge of the details of the survey, but has also contributed many valuable suggestions.

NOTES

(1) The U. S. National Museum Collection and the Biological Surveys Mammal Collections are housed under the same roof, and while each is managed as a separate unit by different officers, they are, in reality, one collection. Taken together, they constitute by far the largest collection in the western hemisphere.

SPECIMENS OF MAMMALS IN THE BIOLOGICAL SURVEYS COLLECTION

Marsupialia (opossums)	526	Rodentia (squirrels, pocket gophers, mice, rats, etc.)	97425
Insectivora (moles, shrews)	7618	Lagomorpha (hares, rabbits, pikas)	5722
Chiroptera (bats)	3882	Artiodactyla (even-toed hoofed mammals, including pigs, deer, oxen, etc.)	2102
Carnivora (flesh-eating mammals, including bears, weasels, wolves, cats, etc.)	20650	Perissodactyla (tapirs, horses)	9
Pinnipedia (walruses, seals)	2	Xenarthra (edentates)	72
Primates (monkeys)	122		

Grand total for the entire mammal collection 138,130

(2) THE MUSEUM OF COMPARATIVE ZOÖLOGY HAS GOOD COLLECTIONS FROM THE FOLLOWING LOCALITIES

United States
- New England
- Florida
- Georgia
- Louisiana
- California
- Texas (fair)
- New Mexico

Canada and Northern N.A.
- Labrador
- Nova Scotia
- Alberta
- Saskatchewan

Central America
- Mexico
- Panama
- Others (few)

South America
- Northwestern part

Australia

Africa
- South Africa
- British East African Colonies
- Liberia
- Madagascar (fair)
- Cameroons (fair)

Asia
- China
- Indochina & Siam
- Mongolia
- Netherlands East Indies
- Philippines
- Eastern Siberia

(3) The mammal collections at the University of Michigan are kept as two separate units, although both are included in the loose administrative unit known as the University Museums. The Museum of Zoology collection is housed in the Museums Building, and that of the Laboratory of Vertebrate Biology in the Vertebrate Biology Building, both on the campus of the University of Michigan. The Laboratory of Vertebrate Biology specimens are practically all *Peromyscus* flat skins, with accompanying skulls and femurs, prepared from animals reared in the laboratory. The Museum of Zoology collection consists of the usual type of study skins from wild-caught specimens.

(4) SPECIMENS OF MAMMALS IN THE AMERICAN MUSEUM OF NATURAL HISTORY

	NORTH AMERICAN	SOUTH AMERICAN	EUROPE	ASIA	AFRICA & MADAGASCAR	AUSTRALIA OCEANIA	ANTARCTICA	TOTALS
Primates	374	3049	2	1144	1744	—	—	6313
Chiroptera	5414	6417	21	2746	1680	2093	—	18371
Insectivora	1957	97	402	2740	1466	—	—	6662
Rodentia	32519	14512	711	12314	8399	4105	—	72560
Carnivora	2808	1390	69	1236	2253	11	127	7894
Ungulata	1329	505	70	1375	3145	14	—	6438
Sirenia	7	20	—	4	1	7	—	39
Edentata	182	757	—	51	131	—	—	1121
Cetacea	190	6	1	17	3	1	—	218
Marsupialia	570	2101	—	90	—	2913	—	5674
Monotremata	—	—	—	—	—	68	—	68
Totals	45350	28854	1276	21717	18822	9212	127	125358

(5) NUMBER OF SPECIMENS FROM PROVINCES IN CANADA IN NATIONAL MUSEUM OF CANADA

British Columbia	7500
Alberta	2600
Ontario	1600
Nova Scotia	1000
Northwest Territories	800
Quebec	1000
New Brunswick	700
Saskatchewan	500
Manitoba	450
Yukon Territory	400
Prince Edward Island	100
Total from Canada	16650
Specimens from miscellaneous sources	481
Grand Total	17131

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Austin Ornithological Research Station ..... Massachusetts

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Yale School of Forestry. Connecticut
Yosemite National Park California
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ACQUIRED HOMIOTHERMISM IN THE PREGNANT SLOTH

By Peter R. Morrison

During a study of temperature regulation in some small tropical mammals on Barro Colorado Isoand, C. Z., a pregnant female of the three-toed sloth, *Bradypus griseus griseus*, became available. This animal was taken without injury and was maintained in good nutritional condition. A well-developed foetus, estimated by Dr. G. B. Wislocki to be near term, was found dead with the animal about two weeks after the experiments described below were made. The normal body temperature of this individual at an external temperature of 25–30°C was 33–35°C. This is in the range reported by other investigators, 32.2–34.1°C by Enders and Davis (1936) and 31.5–36.0°C by Britton and Atkinson (1939).

The response of this animal to an air temperature of 6–9°C was measured by taking rectal temperatures at from 2 to 6 hour intervals. Three runs of 13, 16, and 28 hours duration respectively were made. Fig. 1 shows the results from the 16 hour run which is qualitatively identical with the other two. The body temperature dropped sharply at first, but then stabilized in from 8 to 12 hours at 28.5–29.5°C. In the longest run (28 hours) the temperature remained constant at 28.8 $\pm$ 0.3°C for the last 16 hours. These runs produced no visible ill effects and, on removal from the cold, normal temperature was regained in several hours.

Britton and Atkinson (*op. cit.*), presumably using non-pregnant three toed sloths, obtained quite different results on several individuals at 10–15°C. The average of their two figured curves is shown in Fig. 1. The body temperature of their animals fell to the low 20's in 5 to 6 hours and a state of cold narcosis sometimes set in. Similar experiments on two three-toed sloths reported by Wislocki (1933) showed a fall to 24°C in 3 to 5 hours with one of the animals dying after 9 hours exposure to a temperature of 12–16°C.

Thus, the body temperature of the non-pregnant cloth dropped 10°C or *more*, while under even more rigorous conditions that of the pregnant animal fell *less* than 6°C. It is unfortunate that only a single animal was available and that

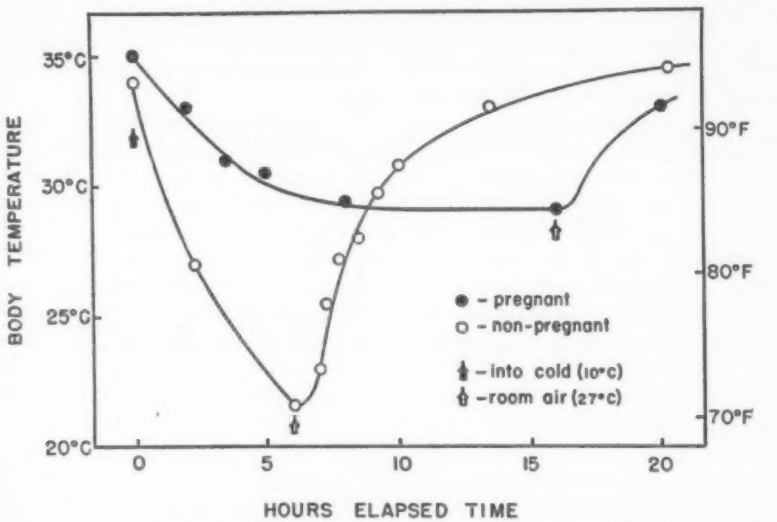

FIG. 1. The effect of cold on the body temperature of the three-toed sloth. The points for the non-pregnant sloth are the average of two curves (20 and 24° C respectively at 6 hours) after Britton and Atkinson (1938).

studies could not be made on this individual after the end of pregnancy but these results stand in such striking contrast to those obtained on non-pregnant animals that they appear significant.

Further, although the normal body temperature was not high it was extremely constant, varying by as little as 0.3°C during a day and staying between 33.0 and 34.0°C despite external temperatures ranging from 25–30°C. Data on the daily variation in a single specimen of *B. griseus griseus* are not available but Kredel (1928) describes a rise and fall of about 2°C during 8 hours in *B. cucullinger cucullinger*.

The improvement of temperature regulation in a primitive animal such as the sloth during a critical period (*i.e.* pregnancy) has interesting implications when

one considers the evolution or origin of homiothermism in mammals. One might expect to find this phenomenon in the primitive monotremes with their low body temperatures, although their regulating ability at low external temperatures is superior to that of the sloth. Records are fragmentary, but in *Echidna* Lendenfeld (1886) reported a rise in temperature of 2°C at egg laying time and noted that the pouch temperature was higher than the cloacal temperature. Burrell (1927) found similarly a pouch temperature 1.5°C higher than the cloacal temperature in an *Echidna* bearing young. In *Ornithorynchus*, however, the average of 22 values for the cloacal temperatures of nesting females (Burrell, 1927, and Wood-Jones, 1923) is no higher than 2 values for non-nesting females (Burrell, 1927, Martin, 1902). A similar situation may be indicated by the observations of Sutherland (1897) on *Phascolarctos cinereus* (koala), an Australian marsupial which resembles the sloth in its sluggish disposition and low body temperature. He found the temperature of the female to be "very decidedly above the ordinary degree of warmth during the breeding season."

Among hibernating mammals, improved temperature control is again related to sexual activity. In the thirteen-lined ground squirrel, *Citellus tridecemlineatus*, the tendency towards hibernation and poikilothermism has been directly correlated with the periods of gonadal inactivity in both the male and the female (Foster et al, 1939). Further, substitution therapy with pituitary or thyroid preparations during the non-breeding season resulted in transient homiothermism. Conversely, extirpation of the pituitary during the breeding season converted the animals into poikilotherms although removal of the thyroid, adrenals, or gonads had no effect. Britton and Klein (1939) reported that the administration of thyroid extract, thyroxin, or pituitary extract to a three-toed sloth had no effect on the body temperature or activity but unfortunately they did not measure the animal's resistance to cold. Experiments of this sort are indicated!

SUMMARY

The body temperature of a pregnant three-toed sloth, *Bradypus griseus griseus*, was found to fall less than 6°C when it was transferred from room temperature of 27°C to a temperature of 10°C. This contrasts to a 10–13°C fall reported by two authors for non-pregnant animals. The normal temperature was not high, but was steady. Despite longer and more rigorous exposure, the pregnant animal suffered none of the ill effects reported for non-pregnant sloths at low temperatures.

These observations were made, incidental to a study of mammals in northern Panama, during the summer of 1941 and were supported in part by a grant from the American Philosophical Society to Dr. R. K. Enders.

I am indebted to Dr. R. K. Enders for both advice and assistance, and to Mr. J. Zetek, Resident Curator of the Canal Zone Biological Area, for his ready cooperation.

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Biological Laboratories, Harvard University, Cambridge, Massachusetts.

DOUBLE HERNIA OF THE DIAPHRAGM ACCOMPANIED BY HYPERPLASIA OF THE BILIARY SYSTEM AND EROSION OF THE THORACIC BODY WALL IN THE DOMESTIC CAT

BY CHARLES A. REED

The incidence of hernia of the diaphragm in man, according to Dorland and Hubney (1926), is about one case in 18,000 patients; of these ruptures the most are on the left side. Although the incidence in other mammals is perhaps no less, the number of reported cases is few. Beattie (Proc. Anat. Soc. Great Britain and Ireland, Feb. 1927) indicates a higher incidence in the Felidae. Indeed, such abnormalities are not worth recording unless unusual accompanying morphological or pathological factors are of sufficient importance to justify publication.

Anatomically, diaphragmatic hernias may be divided into two classes: (1) the peritoneal cavity is abnormally continuous with the pericardial cavity or with one of the pleural cavities; (2) some part of the abdominal viscera bulges into the pericardial cavity or one of the pleural cavities through a weakened place in the diaphragm, but the mesothelial linings of the cavities are not broken. This latter type has been termed "true hernia" of the diaphragm by Abbott (1924) and is generally so designated.

Of the first type, only seven cases have been found in the literature for mammals other than man. One is hernia through the ventral portion of the diaphrahm in a dog, reported by Barry and Donegan (1924); the others all occurred

in cats (Plagens and Bradbury, 1930; Potter, 1938, p. 622; Rifenburgh, Lawson, and Ogden, 1938; Wolfe, 1942, two cases; and Shawhan, 1942)[1]

Two cases, only, were found on record of the second type of hernia, both cases being weaknesses in the central tendon of the diaphragm, through which part of

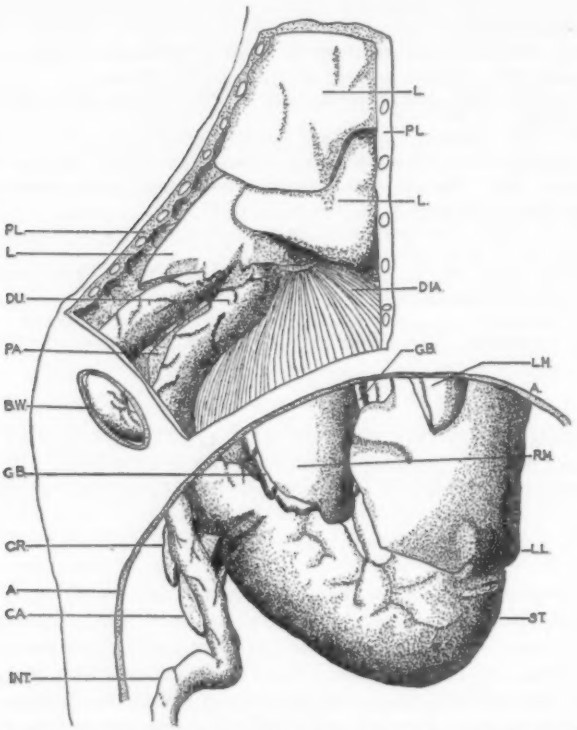

FIG. 1. Ventral view of right pleural cavity and part of abdominal cavity of abnormal cat; the forelimb and latissimus dorsi muscle have been removed. A., cut edge of abdominal cavity; B.W., hole eroded in body wall of pleural cavity; CA., caudal portion of right lateral lobe of liver; CR., cranial portion of right lateral lobe of liver; DIA., diaphragm; DU., duodenum, lying in right pleural cavity; G.B., edge of enlarged gall bladder; INT., intestine; L., lobe of lung; L.L., left lateral lobe of liver; L.M., left median lobe of liver; PA., pancreas; PL., cut edge of pleural cavity; R.M., right median lobe of liver; ST., stomach. × ½.

the liver bulged into the pericardial cavity. One of these was in a cat (Brisco, 1928) and the other in a rabbit (Thomson, 1901).

[1] Since submitting this paper for publication, another case has come to my attention. Hunter (Proc. Anat. Soc. Great Britain and Ireland, Feb., 1927) mentions a cat with a persistent left posterior pleuroperitoneal opening, through which protruded a uterine horn with foetus.

The specimen herein described shows hernia of the first type. This animal is interesting not only because of the abnormality of the diaphragm, but more especially because of the resulting hyperplasia of all parts of the biliary system, and also because of the resulting hole worn through the lateral thoracic wall. The cat was being used for student dissection in comparative anatomy when the abnormalities were discovered. It had been procured from a pound the day after death and injected with an embalming fluid, following which the arteries and veins were injected with colored latex. I wish to thank Mr. George Piternick, former teaching assistant in Zoology at the University of California at Berkeley, for rescuing this interesting specimen from student dissection and placing it at my disposal.

Description of abnormalities—The cat was a large adult male, and appeared normal externally. The right side of the diaphragm was perforated medioventral to its lateroventral angle by a loop of the duodenum with its accompanying mesentery and part of the pancreas; the duodenum extended forward for 6.3 cm into the right pleural cavity; thus approximately 13.0 cm of the intestine lay within the pleural cavity. The common bile duct ran forward through the same perforation, in company with the loop of the duodenum, to reach the ampulla of Vater lying in the right pleural cavity.

The right lung was normal, except that the caudate lobe was less than half its usual size and was deeply concave posteriorly, where the duodenal loop fitted snugly against it.

There was also a second, smaller, opening in the diaphragm, lateral to the one first described, in the posterolateral angle of the pleural cavity, and thus between the body wall and the diaphragm. Through this slit protruded a part of the greater omentum, which formed a small sac, 5.5 by 4.5 cm, whose cavity was continuous with the lesser peritoneal cavity. This second hernia in the diaphragm was but a slit, measuring 4.8 mm in length.

The two openings in the diaphragm were close together; a muscular partition 9.7 mm long dorsoventrally and 6.5 mm mediolaterally separated them. No part of the greater omentum protruded through the larger opening.

This larger rupture measured 1.75 cm transversely and 1.45 cm dorsoventrally, while through it ran the two ends of the duodenal loop, the anterior with a diameter of 1.8 cm and the posterior with a diameter of 2.05 cm. Thus it can be seen that the passage of food through the two constricted loops of the duodenum would have been difficult. The resultant increase in peristaltic action and the consequent increase in pressure had two results: (1) the wearing of a hole through the lateral thoracic wall; (2) constriction of the common bile duct where it entered the pleural cavity, with resulting hyperplasia of the common bile duct, cystic duct, gall bladder, hepatic ducts, and interhepatic bile ducts.

The hole in the body wall of the right pleural cavity was an oval opening lying between the twelfth and thirteenth ribs, the thirteenth being a floating rib and the most posterior one in the cat. This opening measured 29.2 by 8.8 mm; the long axis was parallel with the ribs, and the ventral border was at the level of the ventral free end of the thirteenth rib.

In a normal cat such an opening would be covered dorsally by a slip of the M. serratus posterior inferior, ventrally by a slip of the M. obliquus externus abdominis, and it would be filled wholly, medial to these, by the Mm. intercostales externi and interni. Of these, a remnant of the M. serratus posterior inferior passed in front of the opening to insert on the posterior side of the twelfth rib; a remnant of the M. intercostalis externus passed posteriorly from the twelfth rib but ended at the edge of the opening and was without insertion. The M. latissimus dorsi, which covered the dorsal half of the opening, was not affected.

This opening in the body wall would appear to have been eroded by the peristaltic action of that part of the duodenum pressing against it; indeed, the lateral surface of the descending loop of the duodenum bulged into the opening. However, covering the duodenum, and filling the opening, was that part of the greater omentum which, as has been previously described, was inserted through the smaller and more lateral of the two ruptures in the diaphragm. The edges of the opening were smooth, as a result of the pleura having been rolled out over the edge from within. There was a fusion between the pleura of the posteroventral edge of the opening in the body wall and a part of the omental sac filling it.

The margin of the larger of the two openings in the diaphragm was protected from the peristaltic action of the enclosed duodenal loops by a heavy circular band of tendinous tissue, bounding the hernia.

Speculation concerning the causes of this double hernia of the diaphragm is largely futile, since we know nothing of the history of the cat; there was no evidence of any injury ever having been suffered by the animal. That the abnormality may have resulted from a developmental deficiency in the musculature of the diaphragm, however, is indicated by the fact that on the opposite (left) side from the rupture, but in the same relative position, the diaphragm had no muscle fibers.

The liver was normal in configuration, but all parts of the biliary system were tremendously enlarged. Normally the gall bladder lies in a cleft in the right median lobe of the liver and is an ovoid organ about 2.5 cm long and 1.5 cm wide; in 20 adult cats measured, gall bladder sizes varied from a maximum of 5.3 by 2.0 cm, to a minimum of 1.85 by 0.86 cm.

In this specimen, however, the gall bladder (fig. 2) consisted of a series of lobulated, thick-walled chambers on the right side of the liver, with another smaller chamber lying on the ventral surface of the left lateral lobe of the liver and connected to the right side by a large, thick-walled duct.

One of these lobules of the gall bladder would actually seem to have been the combined true gall bladder, cystic duct, upper part of the common bile duct, and part of the hepatic duct, all greatly enlarged into one common chamber; into this emptied the four major lobules from the right side and the enlarged duct from the left side. These latter lobules are either hyperplastic outgrowths from the gall bladder, or enlargement *in situ* of the interhepatic and extrahepatic bile ducts. In either case, they will be termed gall bladder, and have been so labeled.

The walls of these gall bladder lobules measured from 1.2 to 2.2 mm in thickness, wherever cut; in a normal cat the walls of the gall bladder measure approxi-

mately 0.6 mm. The common bile duct in the abnormal animal had an external diameter of 4.5 mm and an internal diameter of 2.3 mm. In a normal cat the common duct has an external diameter ranging from 0.8 to 2.2 mm; thus, it could be contained within this abnormal one.

The liver of this abnormal cat, wherever cut, showed large bile ducts, 1.0 mm and larger in diameter. The lobules of the gall bladder were filled with a stiff green gel; this may have been liquid in life. The same green gel could be squeezed from the bile ducts on any cut surface of the liver.

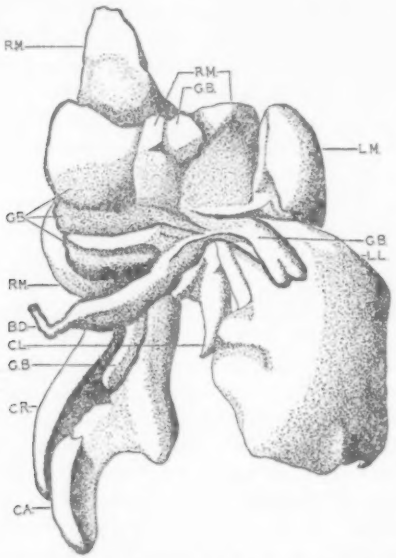

FIG. 2. Liver and gall bladder of abnormal cat in ventral view; the left median and right median lobes of the liver have been turned crania to expose the lobules of the enlarged gall bladder. B.D., common bile duct; CA., caudal portion of the right lateral lobe of liver; C.L., caudate lobe of liver; CR., cranial portion of the right lateral lobe of liver; G.B., gall bladder; L.L., left lateral lobe of liver; L.M., left median lobe of liver; R.M., right median lobe of liver. × ½.

Various factors responsible for complete or partial obstruction of the common bile duct are outlined by Weiss (1935). Elsewhere in the same source, Weiss discusses at length the etiology and pathology of these obstructions. To such a list I wish to add obstruction of the common bile duct by reason of its passage through a small diaphragmatic hernia in company with ascending and descending loops of the duodenum.

It has long been known that jaundice, due to absorption of bile by the lymphatics, is the immediate result of obstruction of the common bile duct. This absorption is forced, in part, by the secretory pressure of the hepatic cells, which

pressure has been measured and recorded in mm of bile in various mammals: between 236 mm and 373 mm in cats (Herring and Simpson, 1907; Mitchell and Stifel, 1916); an average of 300 mm in dogs (Rous and McMaster, 1921b); and 270 mm in man (Ravdin, et al., 1938). Moreover, the pressure remains fairly constant over a long period (Rous and McMaster, 1921b).

The histologic pattern of the liver in cases of such obstruction is also too well known to be presented again, except in outline. The interlobular bile collecting ducts dilate under pressure and undergo hyperplasia; the epithelium of these ducts becomes columnar and is thrown into high complex folds (contrast nos. 3 and 4, Pl. 1); there is extensive proliferation of bile ducts throughout Glisson's capsule; inflammation leads to general sclerosis, first around the interlobular bile ducts, secondly throughout the normally sparse connective tissue of Glisson's capsule, and finally throughout the parenchyma of the liver lobules, reaching the central (hepatic) veins last; the hepatic cords lose their individuality as the cells become densely surrounded by reticular fibers; the hepatic cells at the periphery of the lobules become compressed by the growing mass of connective tissue and the sinusoids become obliterated; the pressure of the obstructed bile decreases the flow of portal blood, leading to portal stagnation, anoxemia of the portal blood, and eventual degeneration of the hepatic cells, especially those nearer the central vein (Rous and Larimore, 1920; Ravdin and Frazier, 1937); the walls of the dilated bile ducts may even lose their epithelium (Weiss, 1935). In short, we have the histologic pattern of calculous or obstructive cirrhosis. The progressive details of obstructive cirrhosis have been described in the cat by a number of investigators (Harley and Barratt, 1901; Stewart and Lieber, 1935; Cantarow and Stewart, 1935; and Stewart, Cantarow, and Morgan, 1937) and need not be repeated here. In the abnormal cat under consideration, the obstruction was not caused by a calculus, but that is immaterial; the histologic pattern is here the same. The hyperplasia of the gall bladder, however, would seem to be unusual.

For an understanding of the etiology and histology of calculous cirrhosis, one must possess an understanding of the normal physiology of the biliary system. The mechanism of this system has received considerable attention from anatomists, and more from physiologists and pathologists. This knowledge has been summarized at various times, and from different points of view, by Mann (1924), Weiss (1935), Schmidt and Ivy (1937), Gorham and Ivy (1938), Carter, Greene, and Twiss (1939), and Lichtman (1942).

There are two primary functions of the gall bladder. The first is to store bile between periods of digestion, and the second is to concentrate the bile while it is being stored (in some mammals with gall bladders, however, the concentrating ability is almost absent, and some mammals, of course, have lost the gall bladder entirely). The first factor is dependent upon the second, for the normal gall bladder is too small for effective storage of unconcentrated material (in those mammals with poor concentrating abilities, or without gall bladders, the dilute bile runs continuously into the duodenum).

The gall bladder is emptied by muscular contraction of its walls, induced by the liberation into the blood stream of the hormone cholecystokinin (CCK), pro-

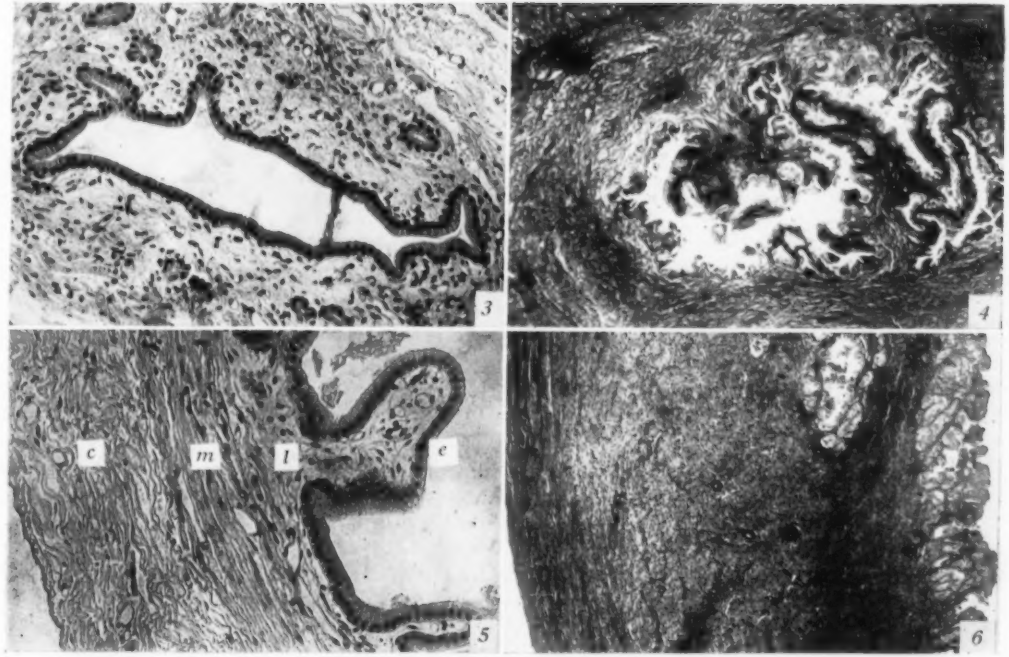

PLATE 1

No. 3. Intra-hepatic bile collecting duct from normal liver of cat, taken from near the gall bladder. × 160; (4) Intrahepatic (interlobular) bile collecting duct from liver of abnormal cat, taken from the distal portion of the left lateral lobe. Contrast with fig. 3. × 52; (5) Cross-section through wall of gall bladder of normal cat. c, perimuscular connective tissue; e, epithelium of mucosa; l, lamina propria of mucosa; smooth muscle layer. × 160; (6) Cross-section through wall of gall bladder of abnormal cat, section taken from region thought to be the original gall bladder. No muscular layer is present. Contrast with fig. 5. ×46.

duced by the intestinal wall when fats or proteins enter the duodenum from the stomach (Ivy and Oldberg, 1928). CCK is a substance separate from secretin, but related to it (Ivy, et al., 1929); CCK inhibits contraction of the sphincter of Oddi (Sandblom, Voegtlin and Ivy, 1935), contracts the muscle of the gall bladder (Doubilet and Ivy, 1938), and is then inactivated by some unknown agent in the blood serum (Greengard, Stein, and Ivy, 1941). Frequent suggestions that CCK cannot, alone, explain the complex functioning of the biliary system led to a search for a neural mechanism; Johnson and Boyden (1943) discovered that, in general, the sympathetic system contracts the sphincter of Oddi and inhibits contractions of the gall bladder, whereas the parasympathetic (vagus) relaxes the sphincter and activates contraction of the gall bladder, thus hastening its emptying.

There are, then, efficient neural and endocrine mechanisms, cooperating for the emptying of the gall bladder under the pressure of the contraction of its own musculature. In addition, peristalsis of the common duct has been observed while the gall bladder was emptying in the opossum (Dubois and Hunt, 1932a) and in man (MacDonald, 1941): presumably this is a phenomenon common to all mammals.

Dubois and Hunt (1932b) have analyzed the mechanism of the flow of bile in the normal cat and found that it begins soon after eating; in some cats two-thirds of the content of the gall bladder is expelled within 45 minutes. When such emptying is impossible, as in the cat under discussion, this pressure is diverted into the bile ducts within the liver, being there augmented by the secretory pressure of the hepatic cells, with the symptoms of obstructive jaundice and the development of obstructive cirrhosis resulting.

Concerning the concentrating activity of the gall bladder, Rous and McMaster (1921a) quantitatively studied the gall bladder of the dog and found bile to be concentrated, mostly by removal of water, to one-eleventh of its original volume; most mammals, including man and the cat, are similar to the dog in this respect. In further work, Rous and McMaster (1921b) discovered that the epithelium of the extrahepatic biliary passages, other than the gall bladder, secretes a thin, colorless, watery mucus, at a higher pressure than the secretory pressure of the hepatic cells. If the gall bladder, with its ability to concentrate bile, is not connected with the obstructed portion of the biliary system, this mucous fluid forces the bile backwards, to be absorbed by the lymphatics of the liver, and fills the obstructed tract with the "white bile" of the surgeons.

In the abnormal cat under discussion, however, the gall bladder had undergone hyperplasia, and was in communication with all parts of the biliary system, so that the system was filled with a heavy, green, concentrated, bile gel.

Inflammation resulting from biliary pressure causes much the same effects in extrahepatic bile ducts as in interhepatic ducts; these have been described in detail by Burden (1926) and need not be repeated here. Moreover, in this abnormal specimen, the cystic and all hepatic ducts, as well as much of the common duct, had merged into one chamber with the hyperplastic gall bladder.

I wish to express my gratitude to Dr. A. B. Burch and Dr. A. A. Koneff, University of California Medical School, for the loan of slides, and to Dr. J. B. deC. M. Saunders, of the same medical school, and to Dr. A. H. Miller, Museum of Vertebrate Zoology at Berkeley, California, for suggestions and criticism.

SUMMARY

Double hernia of the right lateroventral diaphragm was found in an adult male cat. Through the larger and medial of these openings into the right pleural cavity the loop of the duodenum was inserted, carrying the common bile duct with it. Peristalsis of the duodenum had eroded a hole in the lateral body wall of the right pleural cavity; this opening was plugged by a part of the greater omentum, which came through the smaller of the hernias. Constriction of the common bile duct resulted in the hyperplasia of all parts of the biliary system, especially of the gall bladder, and in a histological pattern in the liver identical to that of calculous cirrhosis.

The normal physiology of the biliary system is considered in relationship to these morphological abnormalities.

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HEART-WEIGHT AND BODY-WEIGHT IN RODENTS

By H. Gray

If heart-weight be plotted against body-weight in order to show how the organ grows in relation to the whole body, the stream of points is curved; for convenience it is therefore customary to straighten out the stream by some mathematical transformation. For the heart, fortunately, the desired rectification is simple; logarithm of heart-weight plotted on logarithm of body-weight falls close to a straight line, with the result that its equation is easy to calculate.

Prediction of normal heart-size of laboratory animals on the basis of their body-weight promises practical use, and certainly is of much theoretical interest. The literature contains considerable documentation by authors who have tried to generalize growth-laws by computing the "heart ratio" 100 Heart-Weight/Body-Weight = b, which then is a percentage. It may be written $y = bx$, or $y = bx^a$, a parabola with the exponent alpha = 1. Unfortunately, when the data reported are plotted, the exponent does not remain unity. The size of the error which would result from using the HW/BW% factor may be envisaged by using the heart ratios given by Clark (1927) on the one hand, and on the other using our equations; calculating by each an estimated HW and expressing the deviation of the former from the latter in percentage of the latter. The error averages about 16%, as shown in Table 1.

The truth is that the relation of organ-weight to body-weight is much more closely represented by the law of relative growth; this is a parabola of similar type, but requiring the exponent α, which, although constant within some groups studied, is ordinarily materially less than 1.00, rarely greater. This so-called allometric law has been discussed theoretically and studied for relationships between skeletal part and whole body by zoologists and general biologists who need not be enumerated here. But its application to organ-weights, so much more important for experimental work, has received small attention (Walter and Addis, 1939). The abundant observations and brief treatment by the latter on albino rats have formed the starting point for the present extension of the logarithmic growth law to a larger group of the animal realm, the entire Order of Rodents.

The mathematical notation may be reviewed. Let us call the body-weight in grams, BW or x, and the heart-weight in milligrams HW or y. Now the absolute growth-rate of the organ per unit of age or time t is dy/dt. This is usually less illuminating than the specific growth-rate, i.e., referred both to time and to the size at any moment dy/ydt, or d $\log_e$y/dt. The corresponding specific rate for the whole body is d ln x/dt. For purposes such as ours the most illuminating expression is the ratio of these two specific rates

$$\frac{d \ln y}{d \ln x} = \text{the relative growth rate} = \text{the exponent alpha in the familiar equation}$$

variously written

$$y = b\,x^{\alpha}$$

$$\log y = \log b + \alpha \log x$$

$$Y = B + \alpha X \quad ,$$

where

$$X = \log_{10} (\text{BW in gm})$$

$$Y = \log \ (\text{HW in mg}).$$

If this formula be computed from a normal series of fair extent, we are in a position to predict the size of the organ from the body-weight in a subsequent series of experimental observations, before we are able actually to weigh the organs. Or, from the broader viewpoint of comparative anatomy, we are in a position to compare the obtained constants, particularly alpha, with those obtained for other series. We may wish to know whether other organs grow faster

TABLE 1.—*Error in using heart ratio = HW/BW% factor*

ANIMAL	BW IN GM	HEART RATIO	ESTIMATED HW IN MG.		% ERROR
			By Ratio	By Equation	
House Mouse	16	0.63	101	120	−16
Tame Rat	150	0.41	615	542	+13
	180	0.41	738	623	+18
	240	0.385	928	778	+19
Tame Rabbit	2000	0.29	5800	5094	+14
Average					16

(bigger exponent), or slower than our own series (smaller alpha). If the comparisons are being made *within the same species*, then alpha is called the equilibrium constant and relative growth is called heterauxesis. Or if a comparison is designed to reveal whether, at any given stage of development, a chosen organ grows faster or slower than in other species, that is *between species*, the alpha is called the limiting equilibrium constant, and relative growth is called allometry. When the constants compared prove to be alike, we speak of isauxesis or of isometry; whereas the more usual finding of growth either faster or slower may be termed tachyauxesis or bradyauxesis (Needham and Lerner, 1940).

For study of the heart, the rat is a particularly valuable animal because in comparison with man and other species his heart is free from fat, his diet is constant, at least in our colony here, and his exercise under the caged conditions of the laboratory is more constant than among free-living animals.

METHOD OF TREATING THE DATA

An amazing number of authors have been quite content to evaluate the constants for the rate or slope alpha and the initial growth index b, from two animals

only, namely a pair of values (body-weight and organ weight) for a small animal, and another pair for a large animal. The crudity of this approximation to the postulated straight line law is apparent from any series of animals reported for a species; considerable variability between individuals within the species is conspicuous, and consequently manifests the unreliability of those equations in the literature based on two individuals taken at random. In fact the crudity is such as to hamper comparisons between the constants obtained by varying groups, and as such comparisons are the essence of comparative anatomy and physiology we have felt obliged to resort, despite the enormous increase in labor, to the following method of treatment of the data. It is now seen to be fortunate that a number of editors have had a sufficiently long view to give expensive space in their journals to the details of original observations.

Much more laborious but much more reliable is the utilization of all the animals reported by an author, or, when they are too numerous, use of organ means for several (say 10–20) body-weight classes. Our procedure, therefore, has been to plot the logarithm of body-weight as X and logarithm of organ-weight as Y. Through most of our work the units used are logarithms, not grams. Two lines were pencilled to indicate the approximate borders of the stream of observations, and square brackets used to mark points which lay outside the stream. Such points are (a) frequently due to the youth of the animals concerned, because in youth the organ-body relationship is often distinctly different from that pertaining to most of the growth period; (b) occasionally due to the fact that increase in body-weight does not always cease when the rats have reached maturity but may continue thereafter provided they remain healthy, and this is not true growth but chiefly fat; (c) rarely due to presumptive errors in the record. While such omissions are admittedly arbitrary, they will not be individually discussed because it is reasonable to assume that the true tendency of the lines desired is approximated more closely by use of the data after the exclusions, and also because the outlying exclusions amounted to a minute percentage of the observations plotted.

From the remaining data, then, the constants were computed by least squares. Some remarks on the procedure are necessary in order to discuss the advisable method to be used for pooling data. First, from the items X, Y on each row of the worksheet, the extensions are calculated X^2, XY. From this stage on there may be a choice of procedures.

Within the Group.—The simplest case to be considered may be called the primary group. This is defined as any group of observations which are presumably homogeneous and which present a linear stream of points. Generally we start with one sex of one colony, that is, from one author; subsequently we test in widening groupings: e.g., a species (comprising colonies from several sources), or a genus, a family, an order, a class. Specific examples will be seen as we proceed. For such a primary group, then, we have a certain number of animals, N, each animal with a frequency of 1; or else each weight-group with a corresponding frequency. In either case each row of the worksheet shows the columns X, Y, X^2, XY. These extensions may be summed directly to get unweighted sums, or may be first multiplied by respective frequencies before adding to get the weighted sums.

(a) Unweighted.—The direct sums are SX, SY, SY^2, and S(XY); we compute SX/N = mean of X = $\bar{X}$, and $SY/N = \bar{Y}$; and with these six values we compute the regression equation for the desired line which defines neatly the relation of the organ-weight to body-weight.

(b) Weighted.—Alternatively it may in some cases seem more representative to use weighted sums. This occurs most naturally when the original data were recorded not for individuals, but as mean organ-weights for classes of individuals with body-weights within a certain range. The class body-weight then was usually assumed to be the midpoint of the class weight range, or sometimes the mean body-weight was actually computed. We have then a frequency for the body-weight class on each row on our worksheet, and using each frequency as a factor we multiply each of the four primary extensions on the row, getting fX, fY, fX^2, fXY; addition gives us S(fX), S(fY), $S(fX^2)$, S(fXY) with the number of observations N = Sf. Occasionally, when a few rows each represented a much larger frequency of animals than the other rows on our worksheet, a bias resulted so that the computed line plainly did not fit the stream of points; then the extensions were summed without weighting, and the constants re-computed, with a resulting equation which was a much better fit to the plotted points. In the present paper we have often used weighted sums despite the additional labor involved.

Pooled Groups.—When the line equations have been obtained for each of several primary groups, and these lines lie reasonably close together when ruled in on the plots, the problem arises of pooling. For example, the members of a pool may be males plus females and we want a line representing the species without regard to sex, for comparison with the pool for another species. Or again, the members may be several species within a family, and we need a single equation for comparison with another family. The constants will differ, at times markedly, according to the method used for pooling, hence these must be discussed. They will be described in order of convenience, not order of merit.

Method I, Consolidating the Sums of the Extensions.—A table is made listing on successive rows the several "members" to be pooled, with the N and the four sums already obtained for each. The five columns are added up and these totals used to compute an equation for the pool. By this method those members having the larger N's are given proportionate influence in determining the equation. This is desirable in some pools; for example, suppose one genus comprised 5 animals all about the same size, and another genus comprised 20 animals of varying sizes, and the 25 points are plotted; then a line fitted to all might represent all the genera composing the family much better than a line connecting the two genus-means of 5 and 20 animals respectively.

Method II, Averaging the Slope.—A table is made summarizing on successive rows the constants already evaluated for each member of the pool, namely X, Y and slope (alpha). These three columns are each added, and divided by the number of members in the pool; in other words, each "member" is treated in this method as if it were centered in a single individual animal. The quotients give us the mean X, mean Y, and mean slope, whence we derive the line equation for the pool:

$$\begin{aligned} Y \text{ predicted} &= Y - \alpha \bar{X} + \alpha X \\ &= \log_{10} b \quad + \alpha X, \end{aligned}$$

where the compound term $\log_{10} b$ is the intercept on the Y-axis. By this method, it may be observed, somewhat different results will be obtained for the largest final pooling, according to which poolings are successively selected as appropriate for broader and broader zoological considerations, and also according to the number of groups available for each particular pool.

Method III, Fitting a Line to the Members Each as a Single Point.—A table is made summarizing in successive rows for each constituent member its computed $\bar{X}$, $\bar{Y}$; then treating these means as if individual X, Y; that is, calculating X^2, XY, getting the four sums, which together with the number of rows (members, say species) as N, will yield a regression equation.

In this paper, sometimes one among these methods has been tabulated, sometimes another, sometimes more than one, in which case the one preferred was marked P, and that one is used in any subsequent broader pools.

The end results obtained in this paper, being based on much broader evidence than in most papers treating this type of equation are presented as much closer approximations to the underlying relations than values so far published.

ALBINO RAT

The material with which we begin has been briefly treated by Walter and Addis (*op. cit.*). At that time they judged the data better fitted, as is true sometimes, by introducing a third constant c, making the equation

$$y - c = b\, x^{\alpha} \quad .$$

In the present paper the simpler formula without c has been used throughout. For the rats this new equation-line lies so near theirs that no plot need be reproduced.

Sex.—The effect of sex is seen (fig. 1) to be negligible, at least by comparison with the effects of species and family, which are our main concerns. The finding is therefore of some importance because it makes further analysis of our collected data much easier by pooling the sexes. Strictly speaking, as can be seen from the constants tabulated in Table 2, the male albino has a heavier heart than the female of like body-weight by only 1%; and this is true in most species. However, in an occasional species such as the brown rat, the male heart is lighter.

Variation.—The differences in relative growth rate have been studied by Lerner (1938) on chicken legs by the analysis of variance, and found to fluctuate at different stages of growth. This is important. It will not however be introduced into this paper, partly to save space and partly to avoid confusing the comparisons with which we are at present concerned, namely between different authors, species and families of the animal kingdom. We shall content ourselves with the computation of the sampling errors of the slope in each of the sexes; the standard error of the constant alpha was only 0.00105 for the 1096 male albino rats, and 0.00114 for the 900 females; and the corresponding standard errors of estimate were 0.009 and 0.007.

Colony.—The effect of the strain in different laboratories is discernible in fig. 2. If an investigator wants to take the trouble, he can obviously make somewhat closer predictions by repeating our work on a normal series in his own colony (strain and environment together).

Exercise.—The heart hypertrophy following forced work is particularly notable in the high position of the line got from our calculations on the ingenious

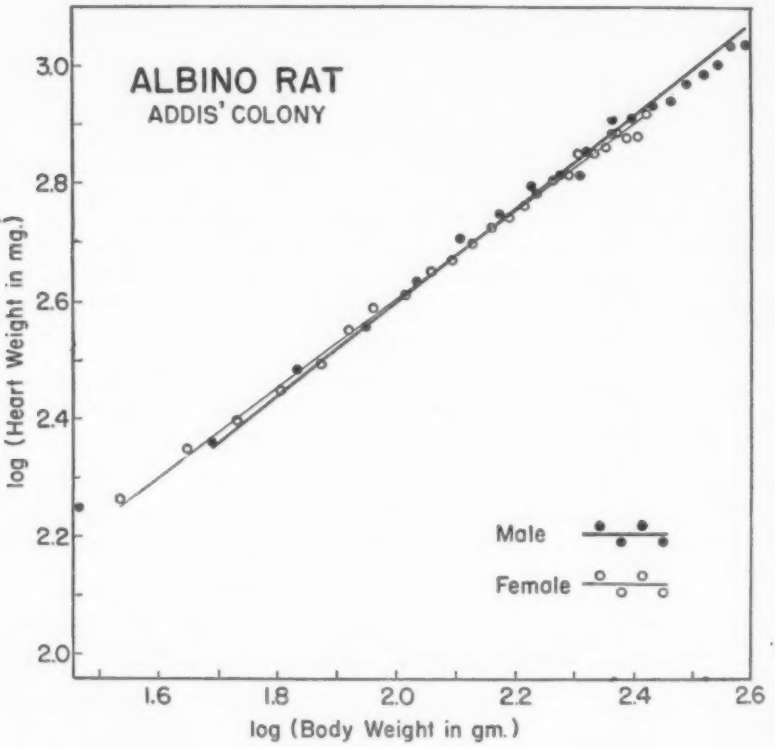

FIG. 1

experimental data of Kirch and Grünbauer (see Gray and Mahan, 1943). It affords beautiful confirmation of Kirch's scanty but suggestive observations on athletes, charted in another paper (Gray and Mahan, 1943) dealing with the heart in man. For the collected 2381 male-female rat hearts, omitting the swimming rats, the albino pool is represented by the heavy line in fig. 2.

FAMILY MURIDAE

The family of which rats (genus *Rattus*) are a part may next be examined. The albino line was copied in fig. 3, where it is comparable with the line formulae

for other species of rats and mice. The albinos had smaller hearts than the other species, perhaps because they got the least exercise; while the largest hearts (always relative to body-weight) belonged to the brown rats. Again, a pool of the several groups is shown as a heavy line, this time for the Muridae as a family. All the important calculations up to this stage are reduced to Table 2.

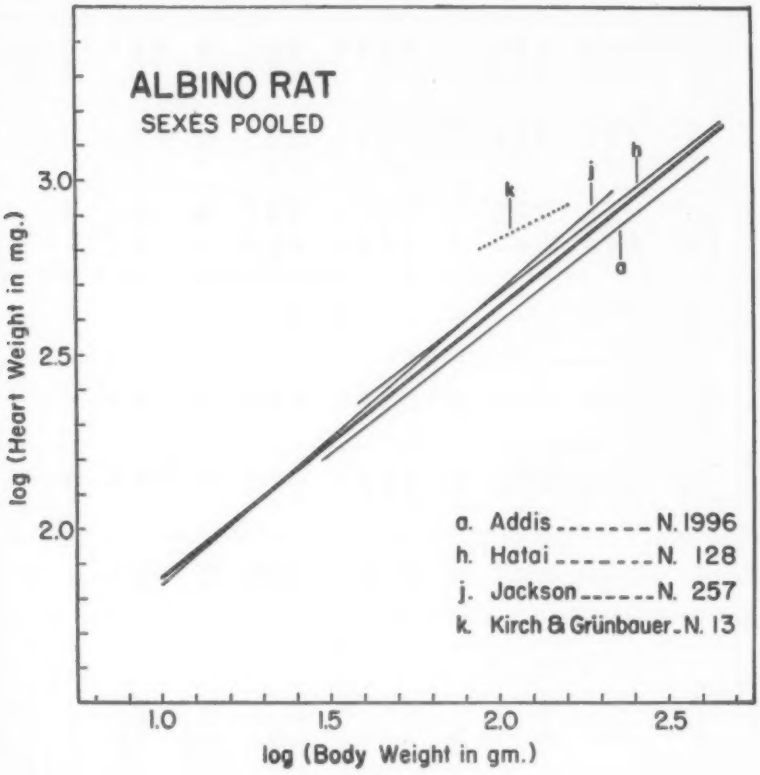

FIG. 2

FAMILY LEPORIDAE

Besides the Muridae, the only family within the Order Rodentia which yielded results remarkable enough to require a separate plot, was the rabbit family. There the reader will be struck, not only by the huge hearts (always speaking relatively of course) of the hares, but also by the larger hearts in free-running wild rabbits as against domestic rabbits. From another angle, presumably allied to arterio-sclerotic degenerative disease, the chart demonstrates the association of big hearts with diets high in cholesterol. (see fig. 4).

TABLE 2.—*Family Muridae*

(Reduced data for log (HW in mg.) = Y, and log (BW in g.) = X)

SPECIES	SOURCE	SEX	NO. OF ANIMALS STUDIED	NO. ROWS USED IN CALC.	METHOD	RANGE OF BODY-WEIGHT IN G.	MEAN X	MEAN Y	SLOPE ALPHA	LOG B
Albino rat, rattus norvegicus albinus	Addis	M	1096	19	IW	40–420	2.216	2.765	0.763	1.073
		F	900	24	IW	30–270	2.120	2.689	0.751	1.097
		MF	1996	43	IP	30–420	2.172	2.731	0.761	1.078
	Jackson (1913)	M	121	6	I	11–213	1.643	2.387	0.855	0.982
		F	136	6	I	10–164	1.683	2.426	0.850	0.995
		MF	257	12	I	10–213	1.664	2.407	0.853	0.988
	Hatai (1913)	M	128	33	I	38–454	2.146	2.787	0.749	1.180
	Pool	M	1345	58	I	11–454	2.157	2.733	0.753	1.108
		F	1036	30	I	10–270	2.062	2.654	0.747	1.114
		MF	2381	88	I	10–454	2.116	2.699	0.752	1.106
				3	IIP				0.787	
Brown rat, rattus norvegicus	Magnan (1913)	M	22	22	I	92–452	2.345	2.968	0.928	0.791
	Hesse (1921)	F	11	11	I	148–343	2.349	3.092	1.136	0.423
		MF	33	33	I	92–452	2.346	3.010	0.980	0.710
Black rat, rattus rattus	Magnan (1913) Hesse (1921)	MF	6	6	I	80–208	2.079	2.715	1.102	0.424
Brown and black together	Magnan (1913) Hesse (1921)	MF	39	39	I	80–452	2.305	2.964	1.036	0.576
Albino, brown and black together, i.e. Genus Rattus	Pool by summing extensions.	MF	2420	127	IP	10–454	2.119	2.703	0.758	1.098
	Pool of 3 values for alpha and of 3 values for $\bar{X}$, $\bar{Y}$	MF	3	3	II		2.180	2.808	0.945	0.748

Gray house mouse	Magnan (1913)	M	17	17	I	8–22	1.124	2.024	0.907	1.005
	Hesse (1921)	F	10	10	I	11–29	1.275	2.123	0.655	1.288
	Rothe (1934)	MF	27	27	I	8–29	1.180	2.061	0.789	1.130
Wood mouse	Magnan (1913)	M	29	29	I	14–28	1.253	2.106	0.733	1.187
	Hesse (1921)	F	32	32	I	12–23	1.219	2.083	0.683	1.250
		MF	61	61	I	12–28	1.236	2.094	0.708	1.219
House mouse and wood mouse, i.e. Genus Mus		MF	88	88	IP	8–29	1.219	2.084	0.750	1.170
All Family Muridae		MF	2508	215	I	8–454	2.088	2.681	0.742	1.132
		MF	5	5	IIIP	8–454	1.767	2.504	0.781	1.124
Swimming albinos	Kirch and Grünbauer (1938) (see Gray and Mahan 1943)		13	13	I	85–157	2.073	2.868	0.502	1.828

Sampling Error.—It may be asked what amount of biological fluctuation around E, the estimate of logarithm of heart-weight, is to be considered in using one of these prediction formulae. Computation for all the formulae in the tables would be excessively laborious; an example of the magnitudes was given in the paragraph above for 1096 albino rats; a second example will now be given for male and female rabbits, domestic and wild together, but excluding hares; the

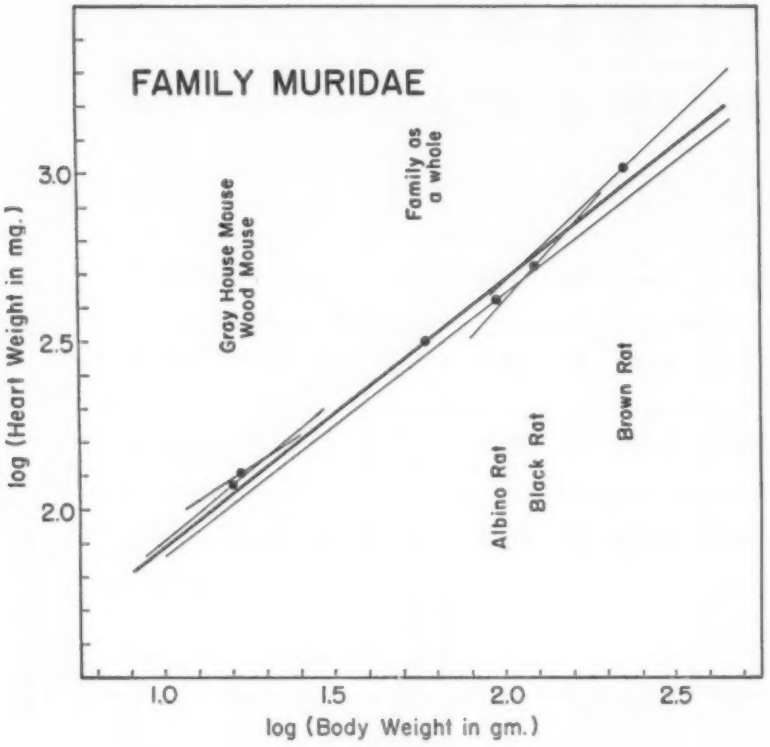

FIG. 3

number in this group was 232, hence the errors come out smaller. The equation for log(HW in mg) is

$$E = 3.673 - (0.8504)(3.214) + 0.8504 \log(\text{BW in gm})$$
$$= 0.9404 + 0.8504 \log \text{BW},$$

and the standard error of estimate was 0.043, with a standard error of the slope alpha = 0.023.

ORDER RODENTIA

The classification used in this paper is obviously open to criticism. Systematic manuals differ and so the arrangement here used cannot conform to the views of all experienced mammalogists. Furthermore, the families do not cover all rodentia of either the old or the new world, nor are they represented in equal numbers by the data found for study.

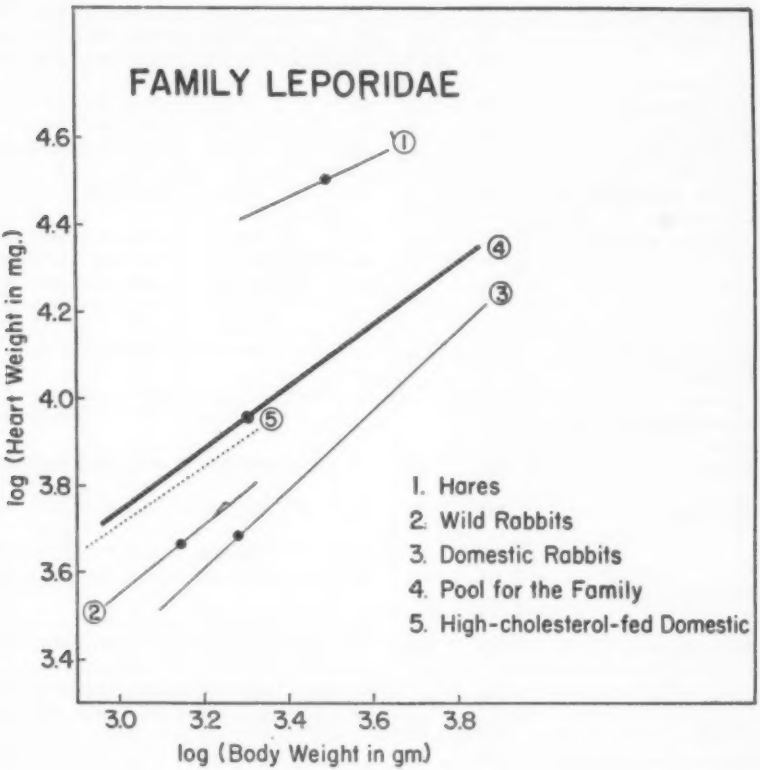

FIG. 4

Now we can survey 10 families (Castoridae, Cavidae, Cricetidae, Dasyproctidae, Hystricidae, Jaculidae, Leporidae, Muridae, Muscardinidae, Sciuridae) of the Order Rodentia. The essential data are in Table 3, and the regression lines are compared in fig. 5. The heavy line, as usual, represents the pool, here for the Rodents. Each black dot places the average for the group indicated in writing

TABLE 3.—*Order rodentia*

FAMILY	SEX	NO. ANIMALS RECORDED	NO. ROWS USED IN CALC.	METHOD	RANGE OF BODY-WEIGHT IN GMS.	MEAN X	MEAN Y	SLOPE ALPHA	LOG B
Dormice = Muscardinidae	M	8	8	I	28–87	1.691	2.561	1.033	0.814
	F	12	12	I	24–95	1.689	2.559	0.984	0.898
	MF	23	23	I	24–95	1.682	2.547	1.020	0.831
Rats and Mice = Muridae	M	1415	140	I	8–454	2.099	2.695	0.732	1.158
	F	1093	77	I	9–343	1.975	2.590	0.755	1.099
	MF	2508	5	IIIP	8–454	1.767	2.504	0.781	1.124
Voles & Hamsters	MF	39	39	I	13–220	1.587	2.274	0.732	1.112
Hamsters	MF	15	15	I	203–335	2.401	3.046	0.961	0.736
Cricetidae, all	MF	54	54	I	13–335	1.813	2.487	0.856	0.935
Jerboa = Jaculidae	F	1	1		122	2.086	3.079	—	—
Squirrels = Sciuridae	M	58	58	I	75–878	2.497	3.311	0.887	1.097
	F	48	48	I	169–958	2.524	3.305	0.897	1.041
	MF	106	106	IP	75–958	2.509	3.308	0.884	1.091
			2	II	75–958	2.511	3.308	0.892	1.069
Guinea pigs & Capybara = Cavidae	MF	180	12	I	215–27670	2.920	3.539	0.918	0.859
Hares and Rabbits = Leporidae									
Hares	MF	12	2	II	1900–4500	3.494	4.508	0.365	3.229
Wild Rabbits	MF	56	56	I	935–2160	3.152	3.664	0.782	1.198
Domestic Rabbits	M	59	59	I	1200–5050	3.264	3.677	0.915	0.690
	F	86	86	I	1700–7300	3.285	3.704	0.915	0.698
	MF	176	176	I	1200–7300	3.275	3.683	0.919	0.674
All Rabbits	MF	232	2	II	935–7300	3.214	3.673	0.850	0.940
All Leporidae	MF	244	244	I	935–7300	3.258	3.719	1.163	0.071
			3	IIP	935–7300	3.307	3.952	0.709	1.607
Agoutis = Dasyproctidae	MF	10	4	I	1373–3627	3.378	4.039	1.203	0.024
Porcupines = Hystricidae	MF	4	3	—	2725–3410	3.472	4.215	—	—
Beaver = Castoridae	M	1	—	—	4180	3.621	4.219	—	—
All families together	MF	3131	663	I	8–27670	2.206	2.805	0.862	0.902
			7	II		2.482	3.196	0.910	0.938
			10	IIIP		2.651	3.366	0.886	1.017

on the figure. For instance, the imaginary average rodent can be seen, in both table and diagram, to have had:

Average for log BW = $\bar{X}$ = 2.6506,
Average for log HW = $\bar{Y}$ = 3.3656; or
Average BW = 447 gm,
Average HW = 2321 mg.

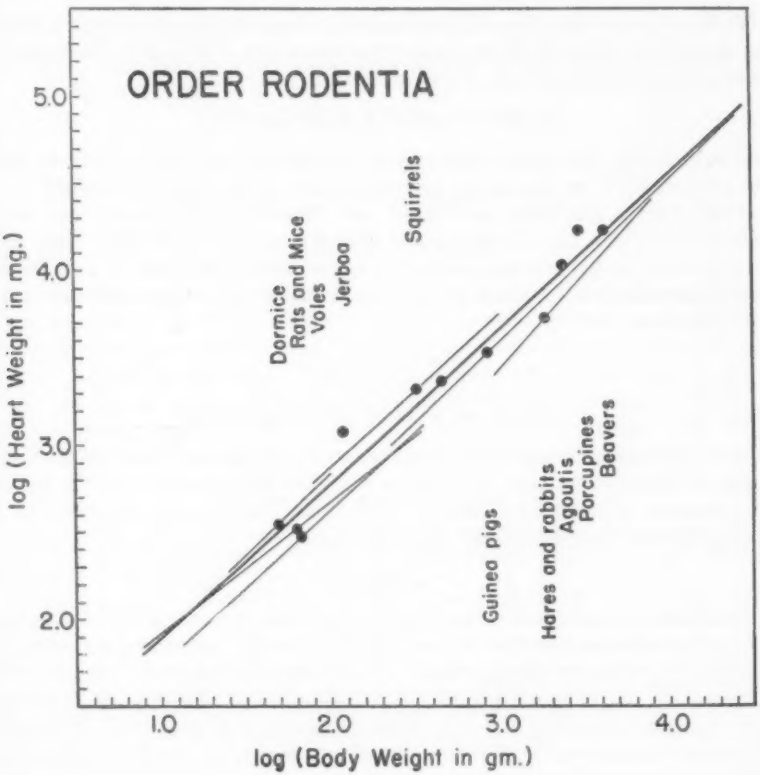

FIG. 5

The jerboa (only 1 specimen) and the 4 porcupines had the biggest hearts relatively to the size of the body, the mice and rats and rabbits had the smallest. The final formula for the 3131 rodents will serve as a paradigm for practical use of the constants listed in Table 3. The predicted or expected value

$$\begin{aligned} E &= \bar{Y} + (X - \bar{X}) \\ &= Y - \bar{X} + X \\ &= \log b + X \\ &= 1.0172 + 0.886\ X; \end{aligned}$$

if then we wish, as a basis of comparison with another series of rodents or with another group of the animal kingdom, to use a rodent weighing say 450 grams, we can write

$$\begin{aligned} \log \text{HW} &= 1.0127 + 0.886(\log 450) \\ &= 3.3679, \text{ and therefore} \\ \text{HW} &= 2333 \text{ mg expected.} \end{aligned}$$

Or if, as is more usual, we wish to compare an experimental animal with a norm, we should pick from one of the tables that line which is nearest in character to our experimental animal, say a male albino rat:

$$\log \text{HW} = 1.0734 + 0.763 \ (\log \text{BW})$$

and substituting the body-weight of the experimental rat, say 164 gm, we find the predicted HW = 580 mg for a normal animal of the same body-weight.

Units Used.—The units used above and throughout this paper have been logarithms to base 10, in order to deal with straight-line equations. They can be converted to the less convenient but occasionally used form of a parabolic curvilinear equation; for example, the formula last given, for the 1096 male rats, would become

$$\begin{aligned} y &= b\,X^a \\ &= 11.84\ x^{0.763} \\ \text{HW in mg} &= 11.84\ (\text{BW in gm})\ 0.763 \end{aligned}$$

It is a pleasure to acknowledge the guidance by Dr. Robert T. Orr of the California Academy of Sciences to books on zoological classification; and the heavy computations done by Mrs. Eleanor M. Tobin. The research was aided by a grant from the Rockefeller Fluid Research Fund.

SUMMARY

Prediction for experimental work on the heart can be better performed by the relative growth formula than by methods hitherto advocated in the literature. This formula expresses the logarithm of heart weight referred to the logarithm of body-weight. It is here applied to 3131 rodent hearts, and the condensed results tabulated as matter of record for special students of heart size. For more immediate comprehension, the main equations are graphed, and the way to use them is illustrated by paradigms.

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TWO NEW RODENTS FROM MEXICO

BY WILFRED H. OSGOOD

During two expeditions to Mexico conducted by Mr. Harry Hoogstraal in cooperation with the Chicago Natural History Museum, various mammals were obtained which are still awaiting careful study. Among those from the expedition of 1941 to the region of the Cerro de Tancitaro in the state of Michoacan are several species of *Peromyscus*, one of which is obviously without a name. This is described below together with a slightly differentiated subspecies of *Oryzomys* obtained by myself during a recent vacation trip.

Peromyscus perfulvus sp. nov.

Type.—Adult male, skin and skull, no. 52041 Chicago Natural History Museum; collected Aug. 10, 1941, by Frank C. Wonder from 10 kilometers west of Apatzingan, Michoacan, Mexico, altitude 1040 ft.; original no. 1263.

Characters.—A medium-sized mouse of mainly clear cinnamon rufous color with a long unicolor and hairy tail well pencilled at the tip; soles of hind feet hairy for proximal fourth; upper parts bright cinnamon rufous with thinly scattered dusky hairs only slightly more numerous on the back than on the sides; face from nose through eyes to base of ears irregularly grayish; a very narrow dusky eye ring; forefeet white without any dusky "wrist" marking; hind feet white with a brownish metatarsal area, in some specimens extending as a narrow wedge to the middle of the upper surface; ears light brownish; tail above and below uniformly brownish (sepia); under parts creamy white, the hairs with plumbeous bases except on the chin and throat where they are wholly white. Immatures are mainly cinnamon drab with undersides of tails slightly lighter than the upper.

Skull mainly as in *spicilegus*, *evides*, and *aztecus;* braincase fairly long, not greatly inflated; supraorbital border sharply angled but not beaded, although somewhat elevated in aged examples; a slight salient angle of frontals just in front of parietals suggesting an incipient postorbital process; interparietal rather large; audital bullae small, proportionately about as in the "*boylei* group."

Measurements.—Average of seven adult topotypes: total length 244.4 (230–254); tail vertebrae 132.4 (125–138); hind foot 25.3 (25–26). Skull of type: greatest length 29.4; basilar length 22.5; zygomatic width 15.4; interorbital constriction 4.7; interparietal 10.2 × 4.5; nasals 10.2; palatine slits 5.3; diastema 7; maxillary toothrow 4.3.

Remarks.—Sixteen specimens of this form are at hand, eleven from the type locality and five from the vicinity of Tacambaro (6 mi. S. and 1 mi. E.) at an altitude of 4000 feet, the latter belonging to the University of California and kindly loaned through Dr. E. R. Hall who with his students is now studying a considerable collection from Michoacan.

It is perhaps unlikely that this is a species wholly distinct from any previously described, but without reviewing a very large amount of material, which is impractical at this time, its exact position is somewhat uncertain. Its cranial characters show conclusively that it has no close affinities to *P. melanophrys* or *P. banderanus*, both of which have representatives in Michoacan. The skull with its rather small audital bullae, its smoothly angled supraorbital border, and its well-proportioned braincase, seems to point to the "*boylei* group" as represented by *evides*, *aztecus*, and *spicilegus* from all of which it differs markedly in external appearance. All of these were somewhat tentatively regarded as subspecies of *boylei* in the revision of 1909 and since that time no additional material of consequence has been studied. Therefore, it is still somewhat uncertain as to their exact status. No direct comparison has been made with *simulus*, which is a much smaller form, but it is not unlikely that this may be the one to which *perfulvus* is most related, although nothing closely resembling either has been reported from the coast of Colima in the region intervening between their ranges.

Conditions at Apatzingan are those of the Arid Tropical Zone characterized by thorn bush and cacti. However, Mr. Wonder, who collected the specimens, reports that they were trapped some 6 miles from there in luxuriant growth surrounding a spring-fed lake rather than in desert scrub. At the same locality, he obtained a series which may be referred to *Peromyscus banderanus vicinior* and which apparently represents the extreme development of its characters. All are very dark-colored with buffy underparts, frequently with heavy ochraceous pectoral areas, and with the median area of the hind feet blackish nearly or quite to the base of the toes. A topotype of *vicinior* from La Salada, for the loan of which I am indebted to the Fish and Wildlife Service, through Dr. Hartley Jackson, although paler, shows these characters only in slightly lesser degree. On referring to the original description of *vicinior*, I find without much pride that it is a mixture based on the assumption that differences between specimens from La Salada and from Los Reyes were seasonal. It now appears that *vicinior* is not a form of the interior highlands but of the hot valleys. The specimens from Los Reyes are only slightly darker than series recently obtained from the vicinity of Zitacuaro in eastern Michoacan. The present material is not sufficient to determine whether these are distinguishable from typical *banderanus*.

Oryzomys fulvescens engraciae subsp. nov.

Type.—Adult female, skin and skull, no. 54164 Chicago Natural History Museum; collected March 18, 1945, by W. H. Osgood from Hacienda Santa Engracia, northwest of Ciudad Victoria, Tamaulipas, Mexico, altitude 240 meters; original no. 7496.

Characters.—Similar to *O. f. fulvescens* but smaller and paler. Skull smaller and narrower interorbitally (in three specimens).

Measurements.—Average of three adults: total length 171; tail vertebrae 92; hind foot 20. Skull of type: greatest length 20.9; basilar length 15.8; zygomatic width 11; interorbital constriction 3.1; diastema 4.7; maxillary toothrow 2.8.

Remarks.—Three specimens of this form from west central Tamaulipas not only extend the range of *O. fulvescens* northward, but appear to differ sufficiently from the typical form of Veracruz to warrant subspecific recognition. They are not only smaller but also much less richly colored. Goldman, in his revision of *Oryzomys* (N. Am. Fauna No. 43, p. 91, 1918), records a single specimen as *fulvescens* from Alta Mira in extreme southern and coastal Tamaulipas. This specimen, kindly loaned by the Fish and Wildlife Service, proves to be a skull without skin. It is smaller than specimens from Veracruz but has the interorbital space wider than in the skulls from Santa Engracia.

The color in this form is much the same as in *O. f. lenis* of western Mexico, but that form is larger and its skull is even larger and broader than in *fulvescens*.

The specimens were caught in brushy hedges between cultivated fields where *Peromyscus* and *Reithrodontomys* were taken in numbers.

Chicago Natural History Museum, Chicago, Illinois.

THE VARYING LEMMING (GENUS DICROSTONYX) IN CANADA

By R. M. Anderson and A. L. Rand

The lemmings of the Genus *Dicrostonyx* have several peculiarities, which have been characterized in detail by Miller (The genera and subgenera of voles and lemmings. North Amer. Fauna, no. 12, pp. 38–40, 1896). The fore feet are highly modified, particularly in the very small thumb with a rudimentary nail and in the powerful third and fourth claws. The latter become greatly enlarged in winter by the growth of the bulbous portion underneath, which grows longer and vertically deeper until it equals or exceeds the upper portion of the claw from which it is separated by a deep lateral groove. The partially split or bifid tip gives the appearance in winter of a double claw that becomes normal in spring when the winter growth drops off. The designation of "Fork-clawed lemming" is correct only for winter specimens. *Dicrostonyx* is the only true rodent that becomes white in winter, but the common name "White lemming" is appropriate only when the animal is in the full winter coat. "Collared lemming" is also an unsatisfactory name because the so-called "collared" appearance is vaguely recognizable only in occasional summer specimens and is totally lacking in winter. A more appropriate collective name for the species of *Dicrostonyx* is varying lemming. The color changes of pelage in general resemble those of the varying hares (*Lepus*).

The American forms of the genus were revised by Glover M. Allen in 1919 (The American collared lemmings (Dicrostonyx), Bull. Mus. Comp. Zool., Harvard University, vol. 62, pp. 509–570). In our area he recognized three species: *D. hudsonius* from the Ungava Peninsula; *D. groenlandicus* from Baffin Island and Ellesmere Island to Northeast Greenland; and *D. rubricatus*, represented by two races, *richardsoni* in the east and *rubricatus* in the west, on the mainland from Hudson's Bay west to Alaska. He suggested that the last two species might be found to be conspecific.

In 1924 Allen and Copeland (Jour. Mamm., vol. 5, pp. 9–11) recorded *groenlandicus* from Victoria Island. Hinton in 1926 (Monograph of the voles and lemmings, etc., vol. 1, pp. 151–158) accepts Allen's views and extended the known range of *groenlandicus* to include Melville Peninsula. Sutton and Hamilton (Memoirs Carnegie Mus., vol. 12, pp. 58–70, 1932) identified Southampton Island specimens as *Dicrostnoyx rubricatus richardsoni*, while Degerbøl (Report of the Fifth Thule Expedition, 1921–24, vol. 2, pp. 9–16, 1935), reviewing the status of certain lemmings from north and west of Hudson's Bay, points

out that they are intermediate between *D. groenlandicus* and *D. rubricatus richardsoni*, and that, as Allen (1919, *op. cit.*) suggested, the species *groenlandicus* and *rubricatus* must be combined under the name *groenlandicus*.

The form *hudsonius* is restricted to the Atlantic coast of Labrador, the south side of Hudson Strait and the east coast of Hudson's Bay, and some nearby islands where no other form of lemming (neither *Dicrostonyx* nor *Lemmus*) occurs. Its pelage recalls that of *groenlandicus* (Hinton, *op. cit.*), but the tooth characters are distinctive and suffice to set it off as a distinct species. This view is buttressed by the study of fossil European materials which show that two forms having tooth characters somewhat similar to the two American species left their remains in European Pleistocene deposits (Hinton, *op. cit.*). However, Hinton points out (p. 147) that the slight dental differences shown are not useful in drawing conclusions as to the interrelationships of known forms, fossil or recent.

The National Museum of Canada has accumulated 163 skins and 219 skulls of this group of lemmings, a collection which allows some conclusions to be drawn and necessitates the description of another hitherto unrecognized form. We are indebted to Mr. Tom H. Manning for the donation of a large series of *D. hudsonius* collected on the mainland on east side of Hudson's Bay and on several adjacent islands; to Mr. Charles Elton, Bureau of Animal Population, Oxford University, and to the Hudson's Bay Company for series of the same form collected on the Belcher Islands by Mr. E. H. Riddell; and to Mr. Charles M. B. Cadwalader, Academy of Natural Sciences, Philadelphia, for the loan of topotypical *rubricatus* from Point Barrow, Alaska.

The species recognizable in Canada stand as follows:

Dicrostonyx hudsonius (Pallas)

Dicrostonyx groenlandicus (Traill)

Both of the above species turn white in winter, but the summer pelage of the different races of *groenlandicus* show pronounced geographical variations. A discussion of these forms follows:

DICROSTONYX HUDSONIUS

Dicrostonyx hudsonius (Pallas). Ungava Varying Lemming.

1778. *Mus hudsonius* Pallas, nov. spec., Quad. Glir. Ord., p. 26, fig. A. B. C. Labrador, probably the east coast.

1897. *Dicrostonyx hudsonius* Bangs. Proc. Biol. Soc. Washington, vol. 11, p. 237. September 17, 1897.

Diagnosis.—A large form with first and second lower molars lacking a posterior internal vestigial angle, lower third molar usually without an anterior inner fold; summer coat of adults nearly uniform buffy gray above, with an indistinct blackish spinal stripe; ear tufts, flanks, and throat buffy or rusty; belly gray, usually strongly tinged with buffy.

Measurements.—Allen (*op. cit.*, p. 516) gives the average of 6 adults as: Total length, 148 mm; tail 20.3; hind foot 22.1. Ten skulls in our collection measure: Basal length, 29.1 (28.0–30.25); zygomatic breadth, 20.5 (18.25–21.5).

Distribution.—Unforested regions of the Ungava Peninsula, including the Atlantic coast of Labrador (Hamilton Inlet-Indian Harbor and Rigolet, Hopedale, Nain, Okak, and Rama), south side of Hudson Strait (Chimo, Hope's Advance, Stupart Bay), and east coast of Hudson's Bay and islands from Digges Islands to Belcher Islands and Great Whale River.

Remarks.—Hinton (*op. cit.*) has pointed out that externally this species is quite similar to *groenlandicus*, but the characters of the first and second upper molars are trenchant, and in view of the fossil evidence from Europe (see Allen and Hinton) it seems advisable to keep this as a distinct species. The character of the interparietal brought out by Allen is relative. The interparietals often tend to be rectangular in shape, and are usually in contact with the squamosals.

We have specimens in full summer pelage from May to early September. An April specimen from Chimo has acquired about half of its summer pelage. October specimens are changing into winter pelage. We have very small young specimens taken August 13 and 23. This species has been bred in captivity from Belcher Islands specimens at the Institute of Parasitology, Macdonald College, Quebec, and we are indebted to that institution for several specimens in the flesh.

Specimens examined: Total number, 51 skins, 58 skulls. **Labrador** (Atlantic coastal area): Hamilton Inlet, Indian Harbour, 2 skins, 2 skulls. (16 additional specimens from Laborador coast, from Hamilton Inlet north to Hopedale, Nain, Okak, and Rama, are recorded by Allen, 1919, op. cit., p. 518.) **Quebec:** *Hudson Strait:* Chimo, near south end of Ungava Bay, 8 skulls, 2 skins; Cape Hope's Advance, 1 skin; Cape Wales, 1 mounted skin; Stupart Bay, 2 skins, collected by Dr. Robert Bell in 1885. *Hudson Bay, east side:* Little River, about 56° north, 1 skin; Port Harrison region (Port Harrison, Mistake Bay, and Point 7), 22 skins, 22 skulls; Second River, about 56° north, 1 skin. **Northwest Territories:** From islands on east side of Hudson Bay near west coast of Quebec, but for administrative purposes attached to Keewatin District, Northwest Territories: 19 skins, 23 skulls; Belcher Islands, 10 skins, 15 skulls; Christie Islands, Nastapoka Bay, 8 skins, 8 skulls; Digges Island, Port LaPerriere, 1 skin, collected by Dr. Robert Bell in 1885.

DICROSTONYX GROENLANDICUS

Allen (1919) has shown that *rubricatus* and *richardsoni* intergrade; Degerbøl, that *richardsoni* and *groenlandicus* intergrade, thus they are conspecific, yet distinct as geographic races. Although in color the race *groenlandicus* approaches *D. hudsonius*, the presence of posterior internal vestigial angles on the first and second upper molars, and the presence of an anterior internal fold on the third lower molar separate this species sharply from *hudsonius*. The color in the summer pelage varies greatly with the subspecies. Four geographic races are recognizable.

Dicrostonyx groenlandicus groenlandicus (Traill). Greenland Varying Lemming.

1823. *Mus groenlandicus* Traill, Scoresby's Jour. Voy. Northern Whale-Fishery, p. 416. Jameson's Land, east of Greenland, about latitude 71° north.

1911. *Dicrostonyx hudsonius groenlandicus* Jacobi, Abhandl. u. Berichte k. Zool. u. Anthrop.-Ethnol. Mus. Dresden, vol. 13, 1908, no. 4, p. 6. 1911.

1919. *Dicrostonyx groenlandicus* G. M. Allen, Bull. Mus. Comp. Zool., vol. 62, p. 533. February, 1919.

Diagnosis.—Adult summer pelage grizzled gray above, with slight rusty tinge on shoulders, ear-tufts and flanks; under parts grayish white, washed with buffy; obscure dusky dorsal stripe present or, more commonly, absent; skull with interparietal reduced in size and usually more acute on anterior margins; nasals more slender and more pointed posteriorly as compared with *richardsoni*. Degerbøl has shown that the difference in dental characters is less than indicated by Allen.

Measurements.—Two of our largest Baffin Island specimens measure: Total length, 132, 132 mm; tail, 10, 15; hind foot, 15, 19; 5 skulls average: basal length, 26; zygomatic breadth, 18.

Distribution.—From northern Greenland to Axel Heiberg Island, Baffin Island, Melville Peninsula, Southampton Island, and Baker Lake, Northwest Territories, intergrading with *richardsoni* in the southern part of the area.

Remarks.—In color, this is a well-marked race. Degerbøl has referred to a specimen from Axel Heiberg Island to this form. Specimens from north and west of Hudson's Bay and Southampton Island have been referred to *richardsoni* by Allen (*op. cit.*), and Sutton and

Hamilton (*op. cit.*). Hinton (*op. cit.* p. 156) refers specimens from north of Repulse Bay to *groenlandicus*. Degerbøl (*op. cit.*) considered specimens from Chesterfield Inlet, north to Melville Peninsula, as intermediate between these two forms, but closer to *richardsoni*.

Specimens from the southern part of the range are certainly larger than Baffin Island specimens (5 Southampton Island skulls average: Basal length, 28.2; zygomatic breadth, 19.5 mm), and Degerbøl has shown that Baffin Island specimens are browner than Greenland specimens, but our series of specimens in summer pelage, including 18 from Baffin Island, 3 from Melville Peninsula, 4 from Iglulik (Fury and Hecla Strait), 2 from Southampton Island, and 1 from Baker Lake, while showing some increase in brownness to the southward, are all closer to the gray Baffin Island specimens than to our specimens of typical *richardsoni*, and are referred to *groenlandicus* on this basis.

Specimens examined.—Total number, 39 skins, 75 skulls. **Northwest Territories:** *District of Franklin:* Baffin Island (Amadjuak Bay, 5; Cape Dorset, 7; Cape Kungovik, 1; Gordon Bay, 1; Lake Harbour, 7; Nettilling Lake, 6; Pangnirtung Fiord, 2; Pond Inlet, 1); Fury and Hecla Strait (Iglulik Island, 4); Melville Peninsula (Bazain Inlet, 3). *District of Keewatin:* Baker Lake, 1; Southampton Island (Coral Harbour, 2 skins with skulls; also 36 additional skulls from Southampton Island).

Dicrostonyx groenlandicus richardsoni Merriam. Richardson Varying Lemming.

1900. *Dicrostonyx richardsoni* Merriam, Proc. Biol. Soc. Washington, vol. 2, p. 26, March 14, 1900. Fort Churchill, west shore of Hudson Bay, Manitoba.

1919. *Dicrostonyx rubricatus richardsoni* G. M. Allen, Bull. Mus. Comp. Zool., vol. 62, p. 525, February, 1919.

1935. *Dicrostonyx groenlandicus richardsoni* Degerbøl, Rep. Fifth Thule Exped., Mammals, vol. 2, 4–5, pp. 9–16.

Diagnosis.—Adult summer pelage nearly uniformly grayish brown, grizzled with black above, with an indistinct narrow dorsal stripe; sometimes with a little chestnut about the shoulders; throat chestnut; rest of underparts gray, usually strongly tinged with buffy. Interparietal rather large, anterior border tending to be bracket-shaped; tongues of parietals usually nearly or quite separating the interparietal from the squamosals.

Measurements.—The largest male in our series measures: Total length, 146 mm; tail, 16; hind foot, 20; the largest female, 145–12–18; basal length, 29; zygomatic breadth, 20.25; two Tavani skulls measure: basal length, 27.5, 29; zygomatic breadth, 20, 20.

Distribution.—The barren grounds west of Hudson's Bay, from Churchill (Manitoba) north to Tavani (Keewatin District), and west to Artillery Lake (Mackenzie District), intergrading with *groenlandicus* to the north, and with the new subspecies, described below, to the northwest.

Remarks.—This is a well-marked subspecies, especially in color of pelage. Specimens from Churchill to Tavani are fairly uniform. Allen (*op. cit.*) recorded two specimens from Artillery Lake as nearly typical *richardsoni* in color of summer pelage.

Specimens examined.—Total number, 28 skins with skulls. **Manitoba:** Churchill, 9. **Northwest Territories:** *Keewatin District:* Kazan River, 15; Tavani, 4. *Mackenzie District:* Thelon Game Sanctuary, northeast of Great Slave Lake, 1.

Dicrostonyx groenlandicus rubricatus (Richardson). Northern Alaska Varying Lemming.

1839. *Arvicola rubricatus* Richardson, Zool. Beechey's voyage, p. 7. American side of Bering Strait, Alaska.

1900. *Dicrostonyx nelsoni* Merriam, Proc. Washington Acad. Sci., vol. 2, p. 25. St. Michael, Norton Sound, Alaska.

1937. *Dicrostonyx groenlandicus rubricatus* Anderson, Mammals and Birds West Arctic district, *in* Canada's Western Northland, Dept. Mines and Resources, Ottawa, p. 110, July 9, 1937.

Diagnosis.—In summer pelage, shoulders chestnut, shading posteriorly into grayish and blackish on hips; indistinct, dark, median dorsal stripe present; throat chestnut; rest of underparts buffy.

Measurements.—Allen (*op. cit.* p. 520) gives the measurements of adults: Total length, 150–157 mm; tail, 12–20; hind foot, 19–22; basal length 28.8 mm; zygomatic breadth, 20.7.

Distribution.—Tundra or unforested regions of northwestern and northern coasts of Alaska from Kuskokwim River (Bering Sea) north to Point Barrow, and southeasterly from Barrow along the coast of Alaska and Yukon Territory to the western edge of Mackenzie delta in extreme northwestern corner of the Northwest Territories.

Remarks.—The Academy of Natural Sciences, Philadelphia, has a large series of this form collected at Point Barrow by E. A. McIlhenny in 1898 at the time of one of the periods of abundance of the species. These were examined some years ago and seven of the specimens were loaned by the Academy for direct re-examination in connection with this revision. Allen (*op. cit.* p. 522) refers three specimens taken by Joseph Dixon in the spring of 1941 from near Demarcation Point on the Alaska-Yukon International Boundary; 52 specimens from Griffin Point a little farther west, as well as other specimens from Herschel Island, Yukon Territory, to this form. He also referred specimens from the Mackenzie Delta to *rubricatus*, but our recent studies led us to consider the latter as representing a new race. The single Herschel Island specimen in the National Museum of Canada is small and immature and is tentatively referred to *rubricatus*. Another specimen in the American Museum of Natural History, taken by the senior author on Flanders Point, Herschel Island, August 9, 1908, is an adult female referred to this form.

Specimens examined.—Total number, 11 skins, 9 skulls. *Alaska:* Point Barrow, 7 (Coll. of Acad. Nat. Sci. Philadelphia); Collinson Point, 1 skull; Barter Island, 3. *Yukon Territory:* Herschel Island, 1.

Discrostonyx groenlandicus kilangmiutak, new subspecies. Mackenzie Varying Lemming.

Type.—No. 3993, Catalogue of Mammals, National Museum of Canada, Ottawa; adult male; skin and skull in fair condition; DeHaven Point, southeast coast of Victoria Island, on west side of Victoria Strait, District of Franklin, Northwest Territories, Canada, about latitude 69° north, longitude 101° 30′ West; July 28, 1918; collected by Joseph F. Bernard.

Diagnosis.—Intermediate in color between the gray *groenlandicus* and the brightly reddish colored *rubricatus;* dorsal stripe usually lacking in adults, but more distinct in young and subadult animals. Differs from *groenlandicus* in being considerably more brightly colored, having the shoulders and anterior dorsal region plentifully mixed with bright reddish and the underparts conspicuously marked with rusty. Differs from *rubricatus* in having considerably less reddish brown in the pelage of the back and shoulders, and the rusty tinge of the underparts paler; skull differs in having the rostrum and nasals more slender. From *richardsoni:* More grayish, largely lacking brownish tint in pelage; interparietal usually somewhat reduced in size; nasals more slender posteriorly; size somewhat smaller.

Measurements.—Measurements of adult specimens are not available in the fairly large museum series, but an adult female, brought out alive with three nearly grown young from Banks Island in August 1944, and died in captivity, January 3, 1945, measured: Total length, 142 mm; tail, 19; hind foot, 18. Two males from Bernard Harbour, taken in November, 1915, measured: Total length, 122, 116; tail, 12; hind foot, 17, 16. Five adult skulls from Victoria Island and Taylor Island average: Basal length, 27.9 mm; zygomatic breadth, 19.6. A fully grown male, which died February 15, 1945, weighed 74 grams.

Distribution.—The Arctic mainland of Canada from the mouth of Mackenzie River east at least to Queen Maud Gulf; southeasterly along the edge of the barren grounds to Aylmer Lake in Mackenzie District; and Banks, Borden, Melville, Taylor, and Victoria islands in Franklin District, Northwest Territories, Canada.

Remarks.—In skull characters, this form is nearest to *groenlandicus;* in pelage it is intermediate between *groenlandicus* and the very different *rubricatus*. The summer coat is much less grayish than in *groenlandicus*, having enough reddish hairs to give a decided pinkish tinge to the coat; readily separable from the brightly colored *rubricatus*. Although it forms an intermediate population, it occupies such a wide area and its characters are so constant, that it should be recognized by name.

The white lemmings are universally known to the Eskimos from Eastern Arctic Canada to western Alaska as *ki-lang-mi-ut'-ak*, meaning "one who comes from the sky" (or clouds). The lemmings work beneath the snow all winter and are seldom seen on the surface except shortly after a blizzard. At such times they seem bewildered and run about here and there, possibly looking for snow tunnels that have been swept away or holes that have been packed with snow. In the summer coat, the Eskimos do not recognize them as differing from the red-backed mice (*Clethrionomys dawsoni*) and tundra mice (*Microtus operarius*), and they are lumped with the mice as *av-i-ngak* (pl. *avingat*). This misconception is natural because the excessive winter growth on the third and fourth fore claws of the white lemmings, which is well known to the Eskimos who say that it has "hoofs like a caribou," is shed in summer.

In 1919 Allen referred specimens from the mainland between Coronation Gulf and the mouth of the Mackenzie to *rubricatus*, and in 1924 Allen and Copeland recorded *groenlandicus* from Victoria Island. Our Taylor Island specimens (6 summer skins with skulls) are somewhat gray, as is the Borden Island summer adult, a slight approach to *groenlandicus*, but a series of summer adults from farther south and west (6 from Victoria Island, 1 from Dolphin and Union Strait, 1 from Victoria Island, 1 from Mackenzie Delta, and 4 out of 5 specimens from Banks Island) show the characters of the new race well. The Melville Island specimen is in white winter pelage and is tentatively referred here. Allen has recorded three specimens from Aylmer Lake as intermediate between *richardsoni* and *rubricatus* and these obviously belong to this form. Our specimens from Sifton and Clinton Colden Lakes are small and immature and tentatively referred here.

The National Museum of Canada received on August 21, 1944, four live varying lemming from Banks Island (Cape Kellett region), one adult female and three nearly grown young, all in full summer pelage. The original lot consisted of one adult male, one adult female, and four young, brought by Supt. D. J. Martin, Royal Canadian Mounted Police, from Banks Island to Norman Wells and then to Edmonton by airplane and later by commercial airplane from Edmonton to Ottawa. The adult male and one of the young died between Norman and Edmonton, apparently by accident, but the others were received in good condition. During the week end between September 9 and 11 the adult female and one of the young began to show a sudden change into winter pelage, with areas on face and flanks noticeably whitish. Another of the young animals began to turn white a few days later, and for several weeks three of the lemmings developed strips and patches of white hairs which contrasted with the reddish areas and gave them a strikingly "pied" appearance. On January 3, 1945, the old female died from no apparent cause, although she was apparently fatter than normal. Her pelage then was white, with the grayish underfur showing as in the snowshoe rabbit when the fur is disturbed. At that time one of the young lemmings still showed grayish brown on back and sides, with a faint dark dorsal stripe; the second one was pale grayish on the head; the third was in full white winter pelage. The change from summer to winter coat is also irregular in the wild state. The senior author collected a young male at Cape Bathurst (near Baillie Island), October 15, 1914, that had a broad brownish dorsal area with a narrow median black stripe; the sides were buffy and the underparts whitish. Another young male taken at the same place on November 14, 1914, was in complete winter coat, except for a light brownish area on chest.

The preferred food of captive animals in winter was buds and bark of willow twigs, fresh apples, carrots, and dry rolled oats.

Specimens examined.—Total number, 41 skins, 56 skulls. **Northwest Territories:** *Franklin District:* Banks Island (Cape Kellett, 5 skins with skulls, and 4 living specimens; Prince of Wales Strait, 2); Borden Island, 1; Melville Island, 1; Victoria Island (Armstrong Point, Prince of Wales Strait, 4 skins with skulls; DeHaven Point, 4 skins, 16 skulls; Walker Bay, 3 skins with skulls); Taylor Island, Victoria Strait, 10 skins, 16 skulls. *Mackenzie District:* Aklavik, 1; Bathurst Inlet, 1; Cape Bathurst, 2; Clinton Colden Lake, 1; Dolphin and Union Strait (Bernard Harbour), 11; Kogaryuak River (Coronation Gulf), 2; Sifton Lake, 1; Warren Point, 1.

Division of Biology, National Museum of Canada, Ottawa.

GENERAL NOTES

THE PERMANENCE OF MAMMAL DENS

Three miles east of Camden in Schuyler County, Illinois, is a den known to have been continuously occupied by various species of mammals since 1911. In that year I trapped my first skunk in the burrow, which even then appeared to have been in use for many years. In the interim up to 1920, more skunks, cottontails, ground-hogs, and opossums were trapped at the same old burrow. Since then the den has at one time or another harbored striped skunks, opossums, ground-hogs, and in 1936 it was the home of a pair of red foxes that successfully raised their litter. In 1940 a large ground-hog lived there, and in 1944 it was again occupied by striped skunks.

Practically all the dens occupied by foxes, striped skunks, and opossums in this part of Illinois are dug by ground-hogs, and I believe this old burrow is no exception. A few other dens in the same vicinity known to have been dug by ground-hogs since 1911 have likewise been continuously occupied by various fur bearers. Nearly all of the hollow tree and log dens in the surrounding woods have disappeared during the 33 year period. Thus it appears that the ground-hog not only digs the dens for other animals in this part of Illinois but that such dens are also relatively permanent.—Lloyd G. Ingles, *Chico State College, Chico, California.*

RESTING NEST OF THE SHORT-TAILED SHREW

On December 2, 1944, along the West Branch of the Salt Fork River near Mayview, Champaign County, Illinois, the authors found an adult short-tailed shrew, *Blarina brevicauda* (Say), in a resting nest in a well rotted log. The cavity in which the nest was located was about four inches long and about two inches wide and had some grass on the bottom.

When caught, the shrew squealed like a mouse and bit the glove on the hand holding it, taking such a firm grip that it was necessary to pry the jaws open with a knife blade in order to get the glove loose. While the shrew was being handled it emitted a musky odor. When released, it acted as though it were blind. After several attempts, it succeeded in finding the opening to its runway and disappeared.—Janet L. C. and William F. Rapp, Jr., *University of Illinois, Urbana, Illinois.*

NOTES ON LONGEVITY IN MYOTIS LUCIFUGUS LUCIFUGUS

Bats banded and recovered at the Southern Illinois Normal University over a period of four years have yielded some information on longevity in the little brown bat. Individuals banded have returned to the summer breeding colony during successive summers (Cagle and Cockrum, Jour. Mamm., vol. 24, no. 4, 1943, pp. 474–492).

A female released May 17, 1940, was subsequently recovered in May 1943 and June 1944. When banded in 1940, it was pregnant and was thus at least one season old. It was again pregnant when recovered in May 1943, but not so in June 1944. The minimum age of this individual was five years. Recovery records of five other females released in 1940 and recovered in 1943 indicate minimum ages of four years in each instance.

The maximum age known for a male is that of an individual banded as an adult in 1940 and recovered in 1943, minimum possible age four years.

Numerous records of known ages of three years for both males and females on the banding of juveniles are available.—Fred R. Cagle, *Peterson Field, Colorado Springs, Colorado.*

BREEDING OF ABNORMALLY COLORED MEADOW MICE

Color mutations in the meadow mouse (*Microtus pennsylvanicus*) are of infrequent occurrence and it appears that efforts at breeding such aberrant individuals have ended in failure. The following case of successful breeding by a pair of abnormally colored meadow mice seems, therefore, to be unique.

In the late winter of 1942, following a sharp decline in meadow mouse population from that observed the preceding spring, a pale cinnamon-colored male meadow mouse was found in a hay field at the Wildlife Research Center, Delmar (Albany County), New York. Two days later a second mouse, even paler than the first and a female, was found in the same type of habitat about a quarter mile distant from the first location. These mice were first placed in a small laboratory cage, but when breeding failed to occur they were transferred to a mesh-covered metal box two feet wide and three feet long. The bottom of this box was covered with sod, which was replaced at frequent intervals. The animals were fed whole corn, apples, and clover.

On July 7 three young mice with eyes open and about 10 days old were found in the box. In general all were of the same pale color as their parents. Two of the young were dead when discovered, one having been recently evicerated. The female died the same day and the third young died two days later. Death of the cinnamon male occurred about a month later after attempts at breeding with a normal female.

The following color description of the abnormally colored mice is based upon Ridgway's scheme of color classification (Color Standards and Color Nomenclature. Washington, D. C. 1912) and in all cases refers to the crown and nape which were slightly darker than the back: adult female, pinkish buff; adult male, light pinkish cinnamon; all young, cinnamon. Both adults and young had dark eyes comparable with those of normal meadow mice.

From the standpoint of inheritance, the slightly darker tone of the progeny can probably be discounted since the young of normal meadow mice tend to be somewhat darker than their parents. The record accordingly suggests that coat color is inherited as a recessive, but this cannot stand as a conclusion in the absence of further breeding data. Study skins of the female and the three young have been preserved.—H. L. Kutz and Ralph H. Smith, *Wildlife Research Center, Delmar, New York.*

NOTES ON THE FEEDING HABITS OF CITELLUS AND EUTAMIAS

On June 21, 1941, at Seven Falls, near Colorado Springs, Colorado, a spot frequented by many visitors, the chipmunks (*Eutamias*—probably *minimum operarius*), and golden-mantled ground squirrels (*Citellus lateralis*) were exceptionally tame and abundant. At this location I observed one golden-mantled ground squirrel leave its rocky haunts and go onto the automobile parking lot, where it carefully examined the wheels and chassis of a car that had just arrived. It apparently found nothing of interest on this car; then it went about 50 feet to another car and repeated the procedure. At frequent intervals it obtained from the wheels grasshoppers or parts thereof, which it ate. When it had obtained all that it could reach from the ground, it climbed onto the chassis and continued searching for, finding, and eating grasshoppers.

In the same general vicinity, I observed 6 *Citellus* eating salted peanuts that people were obtaining from a vending machine and feeding to them. The almost equally numerous chipmunks were not so much interested in the peanuts. Neither the ground squirrels nor the chipmunks cared for a mixture of sunflower, millet, canary, and hemp seed that I offered them, but the chipmunks sampled the bait.—Ernest P. Walker, *U. S. National Zoological Park, Washington, D. C.*

SPECIALIZED CLAW IN LIOMYS

While it may be common knowledge among mammalogists that the little spiny pocket mouse *Liomys* has a differentiated spoon-like claw on the second digit of the hind foot, I find no reference to it in literature. Due to the fact that the specialization is more in structure than size, it may have escaped the attention of others as well as myself. To what use the animal puts this claw is an interesting problem. In most of the pocket mice I examined this spoon claw contained tightly packed particles of soil, suggesting its adaptation for digging. On the other hand the development may in some way be correlated with the coarse pelage and for the express purpose of combing the grooved spines, or it may be utilized in both ways. I find a similar development, although to a lesser degree, in the larger spiny

pocket mouse *Heteromys*.—George G. Goodwin, *American Museum of Natural History, New York, N. Y.*

FRUGIVOROUS RAT IN VIRGINIA

On March 21, 1943, a specimen of *Rattus rattus frugivorus* was caught in the residence of the Director of Seward Forest, in the southeast corner of Brunswick County, Virginia, about 4 miles north of the North Carolina State line. Traps were at once set in the out-buildings at the head quarters, and later in barns and stables on several farms within a radius of about 3 miles. Also five specimens were caught for the writer on two farms about 16 miles northwest of Seward Forest, on the other side of Meherrin River.

In all of this trapping, 24 specimens of *R. r. frugivorus* were taken, but not one of *R. norvegicus*. In some other localities, especially in and around the town of Lawrenceville, the Norway rat seems to be the only species present. In other words, as far as the work done to date is concerned the two species do not occupy the same territory.

The habits of the two species are quite different; *frugivorus* stays close to the upper parts of out-buildings, in hay lofts and attics, while *norvegious* frequents cellars and lower floors and digs burrows under buildings, where it nests.

My largest specimen of *frugivorus*, a male, had a total length of 410 mm, tail 233, hind foot 39. The tail is much longer in proportion to the total length than in *norvegicus*. Of the 24 specimens preserved only 6 were males.—John B. Lewis, *Seward Forest, Triplet, Virginia.*

THE BUNKER BAT IN OKLAHOMA

A female *Antrozous bunkeri* (young of the year, UMMZ No. 78539, alcoholic) was collected by W. F. Blair 3 miles north of Kenton, Cimmaron County, Oklahoma, August 24, 1937. This specimen was erroneously recorded as *Antrozous pallidus* by Blair (Amer. Mid. Nat., vol. 22, p. 103, 1939). Heretofore, *bunkeri* has been known only from the type locality in Barber County, Kansas. The above locality in Oklahoma is more than 200 miles west of the type locality. The maxillary tooth row, including the canine, measures 7.4 mm. This is within the range of measurements for *bunkeri* and greater than those for *pallidus*.—William Henry Burt, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

PLEURITIS IN WILD SKUNK

There has been much concern regarding the periodic die-off of the native skunk (*Mephitis mephitis nigra*) population over much of Ohio. In some localities following an epidemic only an occasional animal can be found; such seems to be the case at present (1944) in southeastern Ohio, including Athens County. Reports of fur-buyers reveal but a mere fraction of the former numbers of skunk pelts. Reports concerning the cause of this epidemic include feline distemper, tularemia, and acute parasitism, but the causitive organism, the disease, and method of transmission have not been definitely determined.

Animals suffering from pleuritis or another ailment are most frequently reported wandering about in broad daylight in a state of blind staggers, followed by death a few days later.

On July 6, 1943, neighborhood boys brought us an adult male skunk captured at mid-day in a farmyard; the animal made little attempt to defend himself and exhibited the familiar unsteady gait. When placed in a cage, he would occasionally lie down; spasmodic convulsions were evident. Once when attacked by a dog he made no attempt to use his scent glands. He could also be handled without danger. Five days later this individual expired.

Post mortem examination revealed a pneumonic condition of the lungs, pleuritis, and extensive petechial hemorrhages in heart and kidneys; the latter were enlarged and degenerated. There were no signs of any abnormal tissue in the other organs. Unlike many skunks examined, the alimentary canal was devoid of innumerable ascarids and other nematodes. Ectoparasites consisted of ticks of the genus *Dermacentor;* several soft-bodied, bluish, blood-sucking arachnids present were not identified.

A pen-reared albino skunk, badly mauled and bitten by the wild individual, did not develop disease symptoms; another captive skunk and litter which ate sputum-covered food

from the diseased specimen suffered no ill effects.—Fred L. Junod, *Veterinarian*, and Hubert Bezdek, *Ohio Division of Conservation, Athens, Ohio.*

A VIRGINIA DEER WITH FIFTY-FOUR TINES

In November of 1943, a group of railroad section hands discovered the carcass of a white-tailed deer (*Odocoileus virginianus*) along the right-of-way of the Erie Railroad near Windham Station, Portage County, Ohio. It is believed that the animal was killed by a train. The workmen, noticing the peculiarity of the antlers, cut off the head for preservation. Upon examination it was found that the antlers possess 54 distinct tines over one inch in length and remnants of 6 others that had deteriorated. Normally no more than 10 or 12 points develop. Probably the odd development and configuration of both the beams and

the tines of this specimen resulted from repeated physical injury while the antlers were in velvet. The decay of the lower extremities of the antlers would indicate that they may have been rested often on the ground. Published reports show that imperfectly developed antlers on the Virginia deer are more usual than not, but the writer does not know of any record with a rack as grotesque or containing as many tines as the one reported here. The head was mounted and the photograph published through the courtesy of the Kent Canadian Club, Inc., the present owners.—Ralph W. Dexter, *Dept. of Biology, Kent State University, Kent, Ohio.*

CYCLOPIA

While the various cyclops giants of mythology are usually considered as purely mythological it is not beyond the bounds of possibility that some human cyclops might have reached maturity, although there is, I believe, no authentic record of such an occurrence.

The chief reason for the almost immediate death of the human cyclops will be noted later.

A most interesting history of "The Problem of Cyclopia" by Adelmann (Quart. Rev. Biol., vol. 11, nos. 2 and 3, 1936) is the source from which most of the following historical data come. Until the work of Etienne and St. Hiliare, in the early part of the 19th century, the whole subject of cyclopia was in a chaotic state. These workers were apparently the first to produce abnormalities experimentally, which work has been carried on by Dareste, Stockard, Adelmann and many others.

Cyclopia should be distinguished from monophthalmia asymmetrica which means the occurrence of a single laterally placed eye, whose opposite failed to develop. Cyclopia occurs in all classes of vertebrates, with the possible exception of the reptiles, and hundreds cases have been recorded, more in man and in the pig than in other groups. In a group of 618 human monsters Mall (Jour. Morph., vol. 19, 1908) found 16 cyclopic and 9 anophthalmic cases.

As stated above, human cyclopses, if they survive at all, live for only a few hours, although a case was *reported* that lived for 10 years. The fact that the nose, if present, which usually has the form of a proboscis, *above* the eye, is often imperforate makes it necessary

Left: Lateral view of lamb cyclops, face turned slightly towards the camera
Right: Side view of the skull of a cyclops lamb similar to the one here described

for the newborn infant to breath through its mouth (unless the mouth is also imperforate); it is thus impossible to breath and suckle at the same time.

In the lower cyclopic vertebrates the mouth is usually imperforate and the animal probably cannot survive for long after the yolk has been consumed, although cases of longer survival, in which the eye gave evidence of visual function, have been described.

Cyclopia has been produced experimentally, along with all sorts of other monsters, by variations in temperature, by various applications of a wide variety of chemicals, and in other ways. A long list of those who have made such experiments, often with striking results, might be given.

As to the cause of cyclopia under natural conditions opinions vary. Perhaps one or more of a number of variations in the embryonic environment may be responsible; possibly defects in the germ plasm may sometimes be the cause. It is, of course, safe to say that the old explanation of prenatal impressions has no factual basis. There are two opposing views as to the morphogenic interpretation of cyclopia: the one that, at first glance, seems the more reasonable, is that two eyes are developed which more or less closely fuse. The other view is that the eyes start as a single optic vesicle which later divides into two, this would make cyclopia a case of arrested development. Adelmann (op. cit.) says: "It may be stated at once that in its original form neither of these explanations is any longer tenable." Stockard, who worked especially on *Fundulus* (top minnow), thought there was a single,

median eye-forming region in the medullary plate which is somewhat in line with the single optic vesicle idea mentioned above. Many delicate experiments, by various workers on the transplantation of these eye-forming areas have been made, with surprising results.

In *cyclopia perfecta* the eye is single in all its parts, showing no evidence at all of doubling. Along with the optic abnormality are other abnormalities of the anterior region of the brain, increasing as the optic fusion increases. In the perfect cyclops the cerebral hemispheres are represented by a single, undivided vesicle. The hypophysis is usually absent. The pineal may or may not be present. The optic nerve may be present as a single nerve or may be absent. The same may be said of the olfactory nerve. The third to twelfth cranial nerves are usually present. The caudal regions of the brain are likely to be more or less normal. Cyclopia is likely to be accompanied by marked abnormalities of the mouth, which add to the horrible appearance of the monster. Other abnormalities such as hare-lip, spina bifida, etc., may accompany cyclopia, although there would seem to be no causal relation between them and cyclopia. The single eye may vary greatly in size from larger than the normal eye to a mere vestige.

Between *cyclopia perfecta* and the normal two-eyed condition is a complete series of intermediate stages, which add interest to the dissection of each specimen.

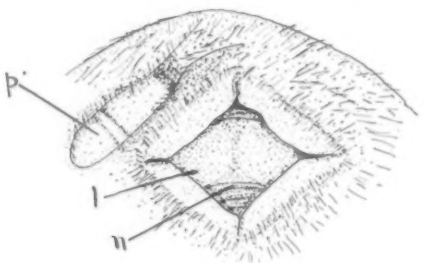

FIG. 1. Sketch of the front view of the eye of a cyclops lamb, proboscis drawn to the left. *l*. lens; *n*, nictitating membrane; *p*. proboscis.

An example of a typical cyclops lamb, recently received by the author, will now be briefly described. So many mammalian cyclopses have been described and discussed in detail that it seems unnecessary to give more than a brief description of the present specimen. This female lamb, probably a Hampshire, was the gift of Mr. James Oliverio, through one of my students, Mr. Frank A. Reda. It was a term lamb, but whether it lived after birth is not known. After being preserved in alcohol for some weeks the entire animal weighed about 1,500 grams. The body seemed normal.

As seen in the photograph, the ears are normal. The lower jaw, the flesh of which projected a considerable distance beyond the tip of the mandibles, curved dorsad as in the skull described in an earlier paper by the author (Anat. Anz., bd. 84, 1937). The upper jaw, which was shorter than the lower, also curved upward and, in the projecting region, was devoid of bone. Between the jaws was the prominent tongue.

From the frontal region projected forward and downward the proboscis, which was 3 cm long, with an average diameter of about 7 mm. It had a distinct constriction in its middle region. Proximal to the constriction it was fairly well covered with hair; the distal half was less hairy, and the tip, which had a small point at the extremity, was practically hairless and with no opening.

The eye (fig. 1) was nearly square, as seen from in front, each side measuring from 13–15 mm. The upper and lower lids were almost exactly alike and could be pulled away some distance from the eyeball. The lateral angles between the lids were much deeper than the dorsal and ventral angles. Between the eyeball and the upper and the lower lids were folds

of skin, perhaps representing the nictitating membranes. Two circular, yellow opacities, seen in a front view, were probably the lenses. The more transparent tissue through which the lenses could be seen may be called the cornea or the front region of the sclera. A dark blue band, about 1 mm wide, extended upward between the above-mentioned lenses and to each side over the lenses, in a bow-shaped curve, to the lateral corners of the eye.

On opening the eyeball from the rear it was found to be so poorly preserved that the contents formed a soft, granular mass in which little detail could be made out. Two more or less spherical masses of this material were apparently the two lenses. An indistinct black layer was probably the remains of the retina and choroid.

The posterior outer surface of the eyeball was slightly better preserved than the internal structures. A single set of superior and inferior recti muscles, and a single set of lateral recti muscles were present. The oblique muscles could not be determined. The brain was so poorly preverved that little detail could be made out. No optic nerve could be seen. The only nerves plainly visible were a pair of medium size, extending to the back surface of the eyeball from about the proper points of origin of the oculomotor nerves. Of course no olfactory nerves were visible.—A. M. Reese, *West Virginia University, Morgantown, West Virginia.*

NOTES ON TWO GORILLA SKELETONS

In view of the rarity of complete gorilla skeletons, it seems worthwhile to present some notes and measurements taken on two well-prepared skeletons of *Gorilla gorilla gorilla* preserved in the museum of the University of Rochester. These two skeletons, a male UR 5280, and a female, UR 5281, were prepared by Mr. Wm. Kruse of Ward's Natural Science Establishment. Attempts to run down the exact origin of the specimens have unfortunately met with failure, but Mr. Kruse recalls that the specimens were secured by a missionary who shot the male, and possibly the female also, in his garden in the Cameroons.

The male skeleton, which appears to be unusually large, presents the following abnormalities and points of interest: There is a prong on the middle of the lower left rib, apparently caused by a bullet or spear wound which split the bone but did not break it entirely. The right rear molar root has eroded the lower jaw bone and the root is projecting through on the inner side. When first examined a small bone, evidently a sesamoid bone, was found lying beneath the left hand of the male. I believe that it fell from the base of the thumb, where it fitted nicely. Unfortunately it was lost while the specimens were being used for class work. The occurrence of a sesamoid bone at this place is occasional in man.

The total length of the male skull is 343 mm, which is equalled or surpassed by only four of the specimens listed by Coolidge in his revision of *Gorilla* (Mem. Mus. Comp. Zool., vol. 50, no. 4, 1929, pp. 293–381, pls. 1–21, maps 1, 2), and of these four one has exactly the same length, and another exceeds it by only one millimeter. None of the skulls listed in Coolidge's later paper on the Vanderbilt African Expedition gorillas from the Sanga River region (Proc. Acad. Nat. Sci. Phila., 1936, vol. 88, pp. 479–501) approach it in size.

It also seems to be unusually broad. Of the skulls in the first paper mentioned above, only 15 equal or exceed it. Seven of these are exactly the same in greatest width. Three are 1 mm wider. Two of the skulls from the Vanderbilt collection are in this width class, one being exactly the same width, the other 4 mm wider. Skulls which are both broad and long seem to be rather rare.

The female skeleton presents no abnormalities or points of interest that I have observed except that the right clavicle is somewhat distorted. It appears to have been broken at some time, and is sickle-shaped. It is somewhat thickened at the base of the curve of what would be the sickle-blade, where it joins the handle, which joins the sternum. The distorted clavicle is the same in actual tip to tip length as the other, 115 mm. Along the curve it measures 126 mm; the other, 118 mm. I am indebted to Dr. S. C. Bishop for making the latter measurement for me.

I am indebted to Dr. Arthur H. Parker and Dr. William C. Ritchie, Rochester Museum of Arts and Sciences, and to Mr. Charles Wray and Mr. J. A. Tihen, of the University of

Rochester, for assistance and advice. Dr. S. C. Bishop has kindly checked the clavicular measurements, and Dr. W. H. Burt, Museum of Zoology, University of Michigan, has criticized the manuscript. The study was carried out during tenure of a research assistantship at the University of Rochester.—Rodgers D. Hamilton, *Museum of Zoology, Ann Arbor, Michigan.*

TABLE 1.—*Cranial measurements, in millimeters, of two gorillas*[1]

MEASUREMENT	MALE	FEMALE
Greatest length	343	225
Zygomatic width		
at greatest width	187	132
at upper jugal point	177	122
at lower jugal point	186	128
Cranial length	221	141
Cranial width	110.5	95
Cranial height	124± (basion restored)	102
Orbital width	110	91
Mastoid width	142	106
Height of occiput	104± (restored)	59.5
Palatal length	120	95
Basal length	243± (restored)	176
Gnathion to nasion	174	126
Nasion to basion	160± (restored)	124
Outside intercondylar width	150	112
Outside intercoronoid width	119	90
Condylar width		
Right	37	30
Left	39.5	29.5
Length of ascending process of ramus		
Right	80	54
Left	83	52
Height of same		
Right	128	90.5
Left	124	90.5
Greatest width across jaws, posteriorly	132	88.5
Length of maxillary tooth row		
Right	86	79.5
Left	85.5	79.5
Outside alveolar width, upper tooth row	73	62.5
Inside alveolar width	44	34
Length of mandibular tooth row		
Right	97	87.5
Left	97	87
Mandibular width outside alveoli	63	58.5
Mandibular width inside alveoli	35	28.5

[1] Skulls measured as described by Coolidge (1929).

ON NORTH AMERICAN HOUSE MICE

In a recent note D. G. Nichols (1944, p. 83) maintains that the *brevirostris* house mice in the United States do not represent introductions from the Mediterranean stock of house mice, but that the lighter animals that are more common in the South, have been developed locally from the darker *domesticus* type. I disagree with this contention.

Homogeneous populations of *Mus musculus domesticus* are found in the northeastern United States, in eastern Canada, Newfoundland, and Labrador (specimens in U. S. Nat. Mus. from St. Lewis, collected by E. Doane and presented by H. H. Bailey), where contacts are, and always were, with northwestern Europe. The bulk of the house mice in Louisiana with its close contacts with France, also represents *M. m. domesticus*. Mice that represent typical *M. m. brevirostris* are known only from areas that had contacts with Spain, or from adjoining territory. The distribution of the two types, therefore, is independent of geographical latitude. The same is true of the distribution of the two forms in southern Europe. In Italy we have *M. m. brevirostris* with unspeckled belly, but on the Adriatic littoral of the Balkans peninsula, and in Greece, we only find the grey *M. m. domesticus* with dark speckled belly. On some of the islands off the coast of Greece, like Corfu, both *M. m. domesticus*, the mainland form, and *M. m. brevirostris* that has come across the Adriatic from Italy, occur (specimens of both collected by Ch. Mottaz, in U. S. Nat. Mus.).

The blackened forms with epistatic black must not be confused with the grey *domesticus*. Blackish individuals occur in both *domesticus* and *brevirostris*. They may be developed in more or less homogeneous populations as in the case of the so-called *jalapae* (=*brevirostris*) with a fairly wide distribution in Central America and along the Gulf coast, or as alternative mutants as in "*perenonotus*" (=*brevirostris*) in Cuba, "*azoricus*" (=*brevirostris*) in the Azores, of "*poschiavinus*" (=*domesticus*), which is rather common in parts of Switzerland. Nor are all the pale forms *brevirostris*. Pale individuals of *domesticus* with speckled belly occur in outdoor populations ("colonies" of Nichols) in many parts of the world. Recently I have seen a series of such mice, in the collection of the Biological Surveys, U. S. Fish and Wildlife Service, from Assateague Island, off the Eastern shore of Maryland, collected by A. Nelson and R. Stewart. The forms described by Jameson (1898, p. 465, pl. 30), from the North Bull, Dublin Bay, Eire, and the pale types identified with *orientalis* and *spicilegus* by O'Mahony (1935, p. 218; 1937, p. 288) from various parts of Eire are also pale *domesticus*, not *brevirostris*.

What D. G. Nichols has seen are populations of mixed origin such as they occur in the wide area where *M. m. domesticus* and *brevirostris* overlap. Such populations have a high degree of variability, and there is always a tendency by sampling, segregation, and selection to develop local strains. In mixed populations obviously there is more variation, and more opportunity for the formation of "colonies." Exactly these conditions obtain in the areas where Nichols has collected, *i.e.* in the southeastern states and in California. In areas with homogeneous populations, as in the northeastern states, (*domesticus*), in northwestern Europe (*domesticus*), or in the western Mediterranean (*brevirostris*), variation within the population is decidedly less. All the types of house mice that we now have in the United States can easily be explained as the result of sampling of characters already present in the introduced stocks of *domesticus* and *brevirostris*. Although reversed mutation may occasionally occur, there is no reason to expect that it had any appreciable effect on the overall picture. This, as elsewhere, is determined by the possibilities of natural spread.

There is no evidence that either the East European house mouse (*M. m. musculus*) or its wild short-tailed ancestor (*M. m. spicilegus*) has been introduced into any part of America.

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ERNST SCHWARZ, *Washington, D. C.*

ON OECOMYS PHELPSI TATE

It has been pointed out verbally by Dr. W. H. Osgood that *Oecomys phelpsi* is based upon a mismatched skin and skull. The skin matches *Oecomys guianae* Anthony very closely indeed; the skull is that of the local *Akodon* (*Chalcomys*) found at Mt. Auyantepui, Venezuela. A check of the remaining *Akodon* procured at the same time reveals one specimen associated with a wrong skull. That skull is not an *Oecomys*, as was to be expected, but a skull of *Thomasomys macconnelli*, which further complicates the matter. The divergence in the collecting dates (Dec. 20 and Feb. 10) effectively precludes a mistake in the field. It is regretted that such a situation has risen. The simplest way to correct it, I believe, is for me to restrict the name *phelpsi* to the skull. *Oecomys phelpsi* then falls as a pure synonym of my *Akodon* (*Chalcomys*) *aerosus* near *chapmani* (Bull. Amer. Mus. Nat. Hist., vol. 76, p. 187). The skin reverts to the status of an unidentified *Oecomys* (or *Rhipidomys*?) without skull.—G. H. H. TATE, *American Museum of Natural History, New York.*

A NOTE ON CROCIDURA FULIGINOSA BLYTH

When writing her paper on *Suncus*, Mrs. Lindsay (Jour. Bombay Nat. Hist. Soc., 1929, vol. 33, pp. 326–340) represented *Suncus fuliginosus* as having the length of head and body 140 mm (p. 328) and later as 5½ inches (p. 335), with the result that she placed it in the same species group as *S. caeruleus*. Incidentally she makes two errors of reference (p. 335)—volume 24 of the Journal of the Asiatic Society of Bengal contains the first description of *fuliginosus* on page 362, not page 326 and volume 17 of Annals and Magazine of Natural History is dated 1856, not 1855.

Blyth (Jour. Asiatic Soc. Bengal, 1855, vol. 24, p. 363), in giving the measurements of *fulignosus* wrote that the total length was 5½ inches, of which the tail was 2¼ inches. Tomes (Ann. Mag. Nat. Hist., 1856, ser. 2, vol. 17, p. 22), commenting upon a specimen sent by Blyth, cited the identical figures above but omitted to show that the length of the tail was included in the total length; he wrote, "head and body, 5½ inches, tail 2¼ inches." This error made by Tomes was repeated by Mrs. Lindsay, who a few lines lower scolded Anderson and Blanford for showing *fuliginosus* a much smaller shrew.

No firm evidence has been offered as to whether *fuliginosus* is a *Suncus* or a *Crocidura*. It may belong with *S. nemorivagus* and *S. soccatus*, if indeed these shrews possess the extra unicuspid which distinguishes *Suncus* from *Crocidura*. They are placed in *Suncus* by Cabrera (Genera Mammalium, pp. 144–145). If it is a *Crocidura* it is apparently the first-described species of the group to which *praedax*, *attenuata*, *dracula*, and *aagardi* belong.—G. H. H. TATE, *American Museum of Natural History, New York.*

RECENT LITERATURE

(Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters)

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LIST OF MEMBERS

LIST OF MEMBERS OF THE AMERICAN SOCIETY OF MAMMALOGISTS

(CORRECTED TO MARCH 15, 1945)

Honorary Members

MILLER, GERRIT S., JR., U. S. National Museum, Washington 25, D. C. (Charter) 1941
SCOTT, PROF. WM. BERRYMAN, 7 Cleveland Lane, Princeton, N. J. 1936
SETON, ERNEST THOMPSON, Seton Village, Santa Fe, N. M. ..... (Life, Charter) 1941

Life Members

ALEXANDER, MISS ANNIE M., Suisun, Calif. ..... Charter
ALLIS, DR. EDWARD P., JR., Palais de Carnoles, Menton (A.M.), France 1922
ARCHBOLD, RICHARD, American Museum of Natural History, New York 24, N. Y. 1929
BAILEY, MAJ. JOHN W., 27 Willway Rd., Richmond 21, Va. 1927
BANNON, HENRY, First National Bank Bldg., Portsmouth, Ohio 1922
BARBOUR, DR. THOMAS, Museum of Comparative Zoology, Cambridge, Mass. ..... Charter
BEACH, WILLIAM N., Room 1518, 551 Fifth Ave., New York, N. Y. ..... Charter
BOLE, BENJAMIN P., JR., Cleveland Mus. Nat. Hist., Cleveland, Ohio 1930
BORDEN, JOHN, Box 442, Muskegon, Mich. 1928
BRANDRETH, COURTENAY, Ossining, N. Y. 1921
CADWALADER, DR. WILLIAM B., 133 S. 36th St., Philadelphia, Penna. 1924
COLBURN, ALBERT E., 3100 Wilshire Blvd., Los Angeles, Calif. ..... Charter
COLTON, HAROLD S., Box 127, Flagstaff, Ariz. 1927
CUTTING, CHARLES SUYDAM, 32 Nassau St., New York, N. Y. 1930
DAVIS, DR. WILLIAM B., Dept. Fish and Game, Texas A. & M. College, College Station, Tex. 1934
DAVIS, WILLIAM T., 146 Stuyvesant Place, Staten Island, N. Y. 1922
DOLAN, BROOKE, 2ND, Villa Nova, Penna. 1933
ELLIS, RALPH, 2420 Ridge Road, Berkeley, Calif. 1926
FRICK, CHILDS, Roslyn, Long Island, New York ..... Charter
GREEN, MORRIS MILLER, 39 So. Wyoming Ave., Ardmore, Penna. 1924
GREGORY, TAPPAN, 105 S. La Salle St., Chicago, Ill. 1925
HARRIS, WILLIAM P., JR., 15410 Windmill Point Drive, Grosse Pointe Shores, Mich. .. 1924

HICKS, DR. LAWRENCE E., Cooperative Wildlife Research Station, Ohio State University, Columbus, Ohio 1936
HODGES, WETMORE, Ennis, Mont. 1927
HOWELL, PROF. A. B., Bucksport, Me. ..... Charter
JACKSON, DR. HARTLEY H. T., U. S. Fish and Wildlife Service, Washington 25, D. C. ..... Charter
KELSON, KEITH R., A.U.S., Station Hospital, Camp Howze, Texas 1941
KIRKHAM, PROF. WILLIAM B., 220 State St., Springfield 5, Mass. ..... Charter
KIRN, ALBERT J. B., Box 157, Somerset, Texas 1922
KOESTNER, E. J., Box 263, Piper City, Ill. 1939
KOFORD, LT. CARL B., 2661 Virginia St., Berkeley, Calif. 1938
LADD, DR. WILLIAM S., 135 East 65th Street, New York, N. Y. 1922
LANG, HERBERT, Transvaal Museum, Pretoria, South Africa ..... Charter
LEIGHTON, DR. ALEXANDER H., Diamond Rock Farm, Paoli, Penna. 1924
LYMAN, PROF. THEODORE, Jefferson Physical Laboratory, Harvard University, Cambridge, Mass. 1921
MANN, DR. WM. M., National Zoological Park, Washington 25, D. C. 1926
MOORE, LT. JOSEPH C., A-3 Staff, A.T.B., Little Creek, Va. 1941
OSGOOD, DR. WILFRED H., Chicago Museum of Natural History, Chicago 5, Ill. ..... Charter
POPE, GUSTAVUS D., 1020 Ford Bldg., Detroit, Mich. 1924
RINDSFOOS, WILLIAM, 10 E. Broad St., Columbus, Ohio ..... Charter
ROGERS, CHAS. H., Museum of Zoology, Princeton, N. J. ..... Charter
SCALON, W. W., c/o Mme. Sofie N. Scalon, Troudowaja No. 6, Nowosibirsk, Sibirie, U. S. S. R. 1927
SIMMONS, EDWARD MCILHENNY, Avery Island, La. 1942
STEWART, PAUL A., Leetonia, Ohio 1940
WALCOTT, F. C., Norfolk, Conn. ..... Charter
WEEMS, F. CARRINGTON, 70 Wall St., New York 5, N. Y. 1930
WAHRHANE, HENRY H., 888 Park Ave., New York, N. Y. 1924
WETMORE, DR. ALEXANDER, U. S. National Museum, Washington 25, D. C. ..... Charter
WHITE, FRANCIS BEACH, Silk Farm Rd., Concord, N. H. ..... Charter
YAMASHINA, MARQUIS YOSHIMARO, 49, Nampeidai-machi, Shibuya-ku, Tokyo, Japan 1932

Annual Members

ABBOTT, CLINTON G., Nat. Hist. Mus., Balboa Park, San Diego 1, Calif. 1922
ADAMS, DR. CHAS. C., 104 Aldeah Ave., Albany 3, N. Y. ..... Charter
ADAMS, I. C., JR., 214 No. 8th St., Columbia, Mo. 1941
ADAMS, LOWELL, 5708 Fayette St., Los Angeles 42, Calif. 1938
AGACINO, E. MORALES, Museo Ciencias Naturales, Apartado Correos No. 593, Barcelona, Spain 1933
ADAMS, WM. C., Department of Conservation, Albany, N. Y. 1933
ALCORN, J. R., Rt. 1, Box 19a, Fallon, Nevada 1939
ALDOUS, CLARENCE M., % U. S. Forest Service, Ogden, Utah 1931
ALDOUS, SHALER E., Lake States Forest Expt. Sta., Univ. Farm., St. Paul, Minn. 1927
ALLAN, PHILIP F., 6537 Broad St., Bookmont, Md., Washington 16, D. C. 1931
ALLEN, DR. ARTHUR A., Fernow Hall, Ithaca, N. Y. ..... Charter
ALLEN, DR. DURWARD L., Rose Lake Wildlife Exp. Sta., E. Lansing, Mich. 1938
ALLIN, DR. A. E., Provincial Laboratory, Ft. William, Ontario 1942
AMADON, DEAN, Amer. Mus. Nat. Hist., New York 24, N. Y. 1938
AMUNDSON, GENO A., Sheldon Natl. Antelope Refuge, Cedarville, Calif. 1942
ANDERSON, JOHN M., East Orwell, Ashtabula Co., Ohio 1939
ANDERSON, DR. RUDOLPH M., Natl. Mus. of Can., Ottawa, Canada ..... Charter
ANTHONY, DR. H. E., Amer. Mus. Nat. Hist., New York 24, N. Y. ..... Charter

ARNOLD, LEE W., c/o Mrs. Elizabeth S. Arnold, 6119 Acacia Ave., Oakland, Calif... 1940
ATZ, JAMES W., 697 Tremont Court, Orange, N. J.... 1936
AUSTIN, DR. OLIVER L., SR., Tuckahoe, Westchester Co., N. Y.... 1930
AXTELL, HAROLD H., Dept. Zoology, Cornell Univ., Ithaca, N. Y.... 1945
BAILEY, ALFRED M., Colorado Mus. Nat. Hist., Denver, Colo.... Charter
BAILEY, FISCHER C., 1220 Ralston St., Reno, Nevada.... 1945
BAILEY, HAROLD H., Box 6333, 820 Alhambra Circle, Coral Gables, Fla.... Charter
BAKER, JOHN H., 1165 Fifth Ave., New York, N. Y.... 1941
BAKER, ROLLIN H., Game Fish, and Oyster Comm., Box 171 Eagle Lake, Tex.... 1938
BALDWIN, PAUL H., Hawaii Natl. Park, Hawaii, T. H.... 1941
BALDWIN, DR. S. GLIDDEN, 139 No. Vermillion St., Danville, Ill.... 1945
BALDWIN, WILLIAM P., JR., 408 W. 26th St., Wilmington, Del.... 1939
BANFIELD, FRANK A. (Inactive).... 1938
BANTA, BENJAMIN H., P.O. Box 605, Reno, Nevada.... 1942
BARBOUR, ROGER WM., 109 Barbour Court, Morehead, Ky.... 1941
BARKALOW, MAJ. FRED S., JR., 207 Washington Ave., Marietta, Ga.... 1934
BARNES, CLAUDE T., 359 10th Ave., Salt Lake City, Utah.... Charter
BARNES, WILLIAM B., 10 State House Annex, Indianapolis, Ind.... 1942
BARRETT, CHARLES H. M., 1339 Valley Place, S. E., Washington 20, D. C.... Charter
BARRINGTON, B. A. (Inactive).... 1940
BARRY, EDWIN M. (Inactive).... 1942
BARTHOLOMEW, GEORGE A., JR., 1507 E. Arch St., Berkeley 8, Calif.... 1942
BARTO, ELIZABETH, Lab. Vert. Biol., Univ. Mich., Ann Arbor, Mich.... 1938
BARTSCH, DR. PAUL, U. S. Natl. Mus., Washington 25, D. C.... 1921
BATCHELDER, CHAS. F., 7 Kirckland Street, Cambridge, Mass.... Charter
BATES, DR. MARSTON, The Rockefeller Foundation, Apartado 2508, Bogota, Colombia 1944
BAUMAN, JOHN E., Room 309 Hotel Taft, Cedar Rapids, Iowa.... 1923
BAUMGARTNER, DR. LUTHER (Inactive).... 1937
BAXTER, WILLIAM, JR., 1018 Trenton Place, Wilmington, Del.... 1942
BAY, DR. J. CHRISTIAN, The John Crerar Library, 86 E. Randolph St., Chicago 1, Ill.... 1931
BAYLIFF, WILLIAM H., Board of Natural Resources, State Office Bldg., Annapolis, Md.... 1943
BEAN, EDWARD H., Box 119, Brookfield, Ill.... 1939
BEARD, D. BARTLETT, Dinosaur Natl. Mon., Jensen, Utah.... 1935
BEAUX, PROF. OSCAR DE, Libreria Mario Bozzi, Via Cairoli 6, Genoa, Italy.... 1930
BEEBE, DR. WILLIAM, 33 W. 67th St., New York, N. Y.... Charter
BEER, JAMES, 2904 Harvey, Vancouver, Wash.... 1940
BEHLE, DR. WILLIAM H., Dept. Biology, Univ. Utah, Salt Lake City, Utah.... 1936
BELL, DR. W. B., 803 Rittenhouse St., N. W., Washington 11, D. C.... Charter
BELLROSE, FRANK C., JR., Illinois Nat. Hist. Survey, Havana, Ill.... 1941
BENCHLEY, MISS BELLE J., Zoological Garden, San Diego, Calif.... 1942
BENNETT, DR. LOGAN J., 206 Forestry Bldg., State College, Penna.... 1939
BENNINGTON, ELWIN E., 2105 N. Skidmore Terrace, Portland 11, Ore.... 1941
BENNIT, DR. RUDOLF, Dept. Zoology, Univ. Missouri, Columbia, Mo.... 1937
BENSON, DR. SETH B., Mus. Vert. Zool., Berkeley 4, Calif.... 1928
BERGER, CAPT. ANDREW J., Research Division, L. A. A. F., Laredo, Tex.... 1942
BEULE, JOHN DAVID, R. D. 2, Montoursville, Penna.... 1939
BEZDEK, HUBERT (Inactive).... 1940
BIRDSEYE, CLARENCE, Eastern Point Blvd., Gloucester, Mass.... 1933
BISHOP, DR. LOUIS B., 450 Bradford St., Pasadena, Calif.... 1927
BISHOP, DR. SHERMAN C., Dept. Biology, Univ. Rochester, Rochester, N. Y.... Charter
BLACK, GEORGE O., Cornell Rd., Oswego, Ore.... 1941
BLAIN, DR. ALEX. W., 2201 Jefferson Ave. E., Detroit, Mich.... 1926

BLAIR, DR. W. FRANK, Lab. Vert. Biology, Univ. Mich., Ann Arbor, Mich. 1936
BLAIR, DR. W. REID, 271 College Rd., Riverdale, New York, N. Y. 1927
BLOSSOM, PHILIP M., 2737½ W. 15, Los Angeles 6, Calif. 1929
BLUNTSCHLI, PROF. DR. HANS, Aebistrasse, 9-, Bern, Switzerland 1930
BLYTH, DAVID, c/o Mrs. Hazel Blyth, The Andrews School for Girls, Willoughby, Ohio 1939
BOLT, BENJAMIN F., 1110 Armor Blvd., Kansas City, Mo. ..... Charter
BOND, DR. RICHARD M., 3607 S. W. Mt. Adams Dr., Portland, Ore. 1938
BONHAM, DR. KELSHAW, P. O. Box 18, Honolulu 10, T. H. 1942
BOOTH, ERNEST S., Walla Walla College, College Place, Wash. 1941
BORELL, ADREY E., Soil Cons. Serv., P.O. box 1354, Albuquerque, N. M. 1925
BORGFELD, H. O., JR., Box 176, Cibolo, Tex. 1939
BORISSIAK, DR. A. A., Beneficiary, Academy of Sciences, UL. Kropotkina 16, Moskva, USSR 1933
BOULWARE, MISS JEAN T., P. O. Box 22, Gridley, Calif. 1941
BOWDISH, BEECHER S., Demarest, N. J. 1921
BOYER, RICHARD HUDSON, 534 N. Broadway, Fresno, Calif. 1941
BRADT, DR. G. W., 704 Leslie Ave., Lansing, Mich. 1927
BRAY, ROBERT S., R. F. D. 2, Herndon, Va. 1939
BRECKENRIDGE, DR. W. J., Mus. Nat. Hist., Univ. Minn., Minneapolis, Minn. 1932
BRIMLEY, H. H., State Museum, Raleigh, N. C. ..... Charter
BROADBOOKS, SGT. HAROLD E., c/o Rev. R. M. Broadbooks, Box 345, Newport, Ore. 1939
BROCKMAN, C. F., Yosemite National Park, Calif. 1943
BROOKE, RAYMOND J., 609 Woodcrest Ave., Ardmore, Penna. 1944
BROOKS, REV. EARLE A., 166 Plymouth Rd., Newton Highlands, Mass. 1921
BROOMAN, RONALD C., c/o Charles Brooman, 62 Allen St., Oakville, Ont. 1939
BROWN, CHARLES P., 15 Union Ave., Slingerlands, N. Y. 1939
BROWN, DR. ELMER EVANS, Box 97, Davidson, N. C. 1944
BROWN, F. MARTIN, Fountain Valley School, Colorado Springs, Colo. 1926
BROWN, LOUIS G., Box 36, Griggsville, Ill. 1940
BROWN, DR. V. E., Dept. Zool., Taylor Univ., Upland, Ind. 1942
BRYANT, FRANKLYN A., Box 12, Jasper, Alberta, Canada 1939
BRYANT, DR. HAROLD C., Grand Canyon, Ariz. ..... Charter
BRYANT, DR. MONROE D., 910 W. Gandy St., Denison, Tex. 1940
BUCHER, G. C., Apartado 470, Santiago de Cuba, Cuba 1936
BUCK, ELLSWORTH B., Pier 23, Rosebank, Staten Island, N. Y. 1940
BUECHNER, LT. HELMUT K., 15 Washington Ave., Scotia 2, N. Y. 1942
BUJAK, B. J., 2547 N. St. Louis Ave., Chicago 47, Ill. 1936
BULLOCK, PROF. D. S., Casilla 2-D, Angol, Chile 1921
BURES, JOSEPH A., 8 Fenway S., Riverdale Apts., Middle River 21, Md. 1944
BURGESS, HAROLD H., c/o Henry F. Burgess, Reese, Mich. 1944
BURGESS, THORNTON W., 61 Washington Rd., Springfield, Mass. ..... Charter
BURMEISTER, MELVIN, 6143 Melrose St., Chicago, Ill. 1938
BURNS, FRANK L., Berwyn, Penna. ..... Charter
BURROUGHS, R. D., Game Division, Dept. Cons., Lansing 13, Mich. 1938
BURT, DR. WILLIAM H., Mus. Zoology, Univ. Mich., Ann Arbor, Mich. 1926
BUSS, IRVEN O., 1101 3rd St., Menomonie, Wisc. 1941
CABOT, WILLIAM B., 447 Marlboro St., Boston, Mass. 1922
CABRERA, ANGEL, Calle 64, no. 584, La Plata, Argentina ..... Charter
CADWALADER, CHARLES M. B., Ft. Washington, Penna. 1930
CADWELL, HOWARD, 354 Lamark Dr., Snyder, Buffalo 21, N. Y. 1944
CAGLE, DR. FRED R., Museum, Southern Ill. Normal Univ., Carbondale, Ill. 1942
CAHALANE, VICTOR H., Natl. Park Service, Merchandise Mart, Chicago 54, Ill. 1930
CALHOUN, JOHN B., Ohio State Univ., College of Agriculture, Columbus 10, Ohio 1940

CAMPBELL, DR. BERRY, Univ. Minn. Med. School, Minneapolis, Minn. 1934
CAREY, DR. JOSHUA HARLAN, 1619 7th St., Couer d' Alene, Idaho 1945
CARR, WILLIAM H., Trailside Museums, Bear Mountain Park, N. Y. 1926
CARROLL, DR. MITCHEL, Franklin & Marshall College, Lancaster, Penna. 1922
CARTER, T. DONALD, Amer. Mus. Nat. Hist., New York 24, N. Y. 1922
CASAMAJOR, PROF. L., 706 W. 168th St., New York 32, N. Y. 1922
CASSEL, J. FRANK, 1529 Dauphin Ave., Wyomissing, Penna. 1944
CASTLE, DR. WILLIAM E., Hilgard Hall, Univ. Calif., Berkeley 4, Calif. 1930
CHAMBERLAIN, EDWARD B., The Charleston Mus., Charleston 16, S. C. 1923
CHAPIN, DR. JAMES P., Amer. Mus. Nat. Hist., New York 24, N. Y. Charter
CHAPMAN, DR. FLOYD B., 1944 Denune Ave., Columbus, Ohio 1937
CHASE, HENRY B., JR., 517 Decatur St., New Orleans, La. 1924
CHATTIN, JOHN E., (Inactive) 1939
CHAWORTH-MUSTERS, JAMES L., c/o R. Kellogg, U. S. Nat. Mus., Washington 25, D. C. 1933
CHEESMAN, WILLIAM H., U. S. Dept. Agr., Bur. Plant Industry, Washington 25, D. C. Charter
CHENEY, L. M., P.O. Box 191, San Antonio, Tex. 1942
CHRISTIAN, LT. JOHN J., 87 West Union St., Shickshinny, Penna. 1944
CHRISTIAN, WAYNE G., 122 S. Fillmore, Maryville, Mo. 1940
CHURCH, MORTON L., 1626 Queens Road West, Charlotte, N. C. Charter
CLARK, DR. JAMES L., Amer. Mus. Nat. Hist., New York 24, N. Y. 1926
CLARKE, DR. C. H. D., Dept. Lands and Forests, Royal Ontario Mus. Zool., Toronto, Ontario 1938
CLARKE, DONALD M., (Inactive) 1942
CLENNON, ROY L., (Inactive) 1942
CLINKSTON, PHILIP (Inactive) 1941
COBB, DR. W. MONTAGUE, Medical School, Howard Univ., Washington, D. C. 1933
COLBERT, DR. EDWIN H., Amer. Mus. Nat. Hist., New York 24, N. Y. 1930
COLE, DR. LEON J., Genetics Dept., Univ. Wisc., Madison 6, Wis. 1922
COLEMAN, H. SHIRL, State Game Comm.,Carson City, Nev. 1939
COLEMAN, PROF. ROBERT H., Route 5, Box 615, Charleston, S. C. 1928
COMPTON, LT. LAWRENCE V., 409 W. Webster St., Pittsburg, Kansas 1929
CONISBEE, L. R., 43 Spenser Rd., Bedford, Eng. 1936
CONSTANTINE, DENNY G., 1071 N. Wilton Pl., Hollywood, Calif. 1942
COOK, LT. ARTHUR H., 7 Rural Place, Elsmere, N. Y., c/o Robert W. Darrow 1939
COOK, DAVID B., 12 McPherson Terrace, Albany, N. Y. 1940
COOK, FANNYE A., 1119 Pinehurst, Miss. 1925
COOKSON, MRS. MARY SNYDER, 9303 Montgomery Ave., Chevy Chase 15, Md. 1932
COOLIDGE, MAJ. HAROLD J., JR., 3106 Cleveland Ave., Washington 8, D. C. 1926
COPE, JAMES B., Patuxent Refuge, Bowie, Md. 1943
COPELAND, DR. MANTON, Bowdoin College, Brunswick, Maine Charter
COSTLEY, RICHARD J. (Inactive) 1942
COTTAM, DR. CLARENCE, U. S. Fish and Wildlife Service, Merchandise Mart, Chicago 54, Ill. 1929
COUCH, LEO K., U. S. Fish and Wildlife Service, Merchandise Mart, Chicago 54, Ill. Charter
COUFFER, JACK, 1625 Country Club Drive, Glendale 8, Calif. 1941
COUNTRYMAN, WILLIAM DOUGLAS, 210 North First St., De Kalb, Ill. 1942
COVENTRY, PROF. A. F., Dept. Zoology, Univ. Toronto, Toronto 5, Ontario 1935
COWAN, DR. IAN MCT., Dept. Zoology, Univ. British Columbia, Vancouver, B. C. 1933
CRABB, DR. WILFRED D., 3626 Vine Ave., Sioux City 20, Iowa 1940
CRANDALL, LEE S., N. Y. ZOOLOGICAL PARK, New York, N. Y. 1922

CREWS, ARTHUR K., 424 Federal Bldg., Spokane, Wash. 1942
CRIDDLE, STUART, Treesbank, Manitoba, Canada ..... Charter
CROSS, E. C., Royal Ont. Mus. Zool., Toronto, Ontario 1936
CULBERTSON, A. E., Dept. Biology, Fresno State College, Fresno, Calif. 1938
DALE, FREDERICK H., Dept. Cons., Game Div., Lansing 13, Mich. 1935
DALKE, DR. PAUL D., Fish & Wildlife Serv., Univ. Missouri, Columbia, Mo. 1928
DALQUEST, WALTER W., Mus. Vert. Zool., Berkeley 4, Calif. 1937
DAMON, DAVID, Glennie, Mich. 1934
DARBY, ROLLO E., 776-6th St., Apt. 3, Hayward, Calif. 1941
DARLING, PROF. C. A. Dept. Biology, Allegheny College, Meadville, Penna. 1935
DARROW, ROBERT W., 7 Rural Place, Delmar, N. Y. 1932
DAVEY, DR. WINTHROP N., University Hospital, Ann Arbor, Mich. 1944
DAVIS, D. DWIGHT, Chicago Mus. Nat. Hist., Chicago 5, Ill. 1930
DAVIS, DR. DAVID E., 721 Elmwood Ave., Wilmette, Ill. 1936
DAVIS, GEORGE W., 148 Northfield St., Montpelier, Vt. 1935
DAVIS, JOHN, Mus. Vert. Zool., Berkeley 4, Calif. 1942
DAVIS, LT. LYLE L. (Inactive) 1941
DAWSON, EVERETT T., 402 Federal Office Bldg., Houston 14, Tex. 1944
DAY, ALBERT M., U. S. Fish and Wildlife Service, Merchandise Mart, Chicago 54, Ill. 1924
DEARBORN, DR. NED, 12 Hillside Ave., Littleton, N. H. ..... Charter
DEICHMANN, ELIZABETH, Mus. Comp. Zool., Cambridge, Mass. 1925
DE LURY, DR. RALPH E., Dominion Observatory, Ottawa, Ontario 1925
DEMERITT, PROF. D. B., Dept. Forestry, Univ. Maine, Orono, Maine 1936
DEMING, OSCAR V. (Inactive) 1943
DICE, DR. LEE R., Lab. Vert. Biol., Univ. Mich., Ann Arbor, Mich. ..... Charter
DILLE, FREDERICK M., 822 Grand Ave., Nogales, Ariz. ..... Charter
DILLEHUNT, HARRY B., JR., 214 W. Read St., Baltimore, Md. 1926
DILLON, OLAN WILLIAM, JR., P.O. Box 811, Seguin, Texas 1944
DIRKS-EDMUNDS, DR. J. CLAIRE, P. O. Box 111, McMinnville, Ore. 1941
DIXON, JOSEPH, 1735 Allston Way, Berkeley, Calif. ..... Charter
DOREMUS, HENRY M., Towaco, N. J. 1940
DOUTT, J. KENNETH, Carnegie Museum, Pittsburgh, Penna. 1927
DOWNING, S. C., Royal Ontario Mus. Zool., Queen's Park at Bloor St., Toronto 5, Ontario 1945
DOZIER, HERBERT L., Blackwater Refuge, Cambridge, Md. 1940
DREYER, MRS. OLIVER, Box 270, Texarkana, Arkansas, ... 1939
DUNK, F. A., Div. Prov. Mus., Toronto & Eight, Regina, Saskatchewan 1929
DUNN, PROF. E. R., Haverford College, Haverford, Penna. 1927
DURRELL, JAMES S., R. R. # 4, Wills Point, Tex. 1942
DURHAM, DR. FLOYD E., 3314 Mesa Dr., San Gabriel, Calif. 1938
DURRANT, PROF. STEPHEN D., Dept. Zoology, Univ. Utah, Salt Lake City, Utah 1934
EADIE, DR. W. ROBERT, Stimson Hall, Cornell Univ., Ithaca, N. Y. 1936
EASTWOOD, SIDNEY K., 5110 Friendship Ave., Pittsburgh 24, Penna. 1929
EDGE, MRS. CHARLES N., 1200 Fifth Ave., New York, N. Y. 1930
EDGE, DR. ELTON R. (Inactive) 1931
EDMINSTER, FRANK C., 312 Lincoln Ave., Lansdowne, Penna. 1938
EDWARDS, CAPT. ROBERT, A. A. F., Hamilton St., Hamilton, N. Y. 1944
EHIK, DR. JULIUS, Hungarian Natl. Museum, Budapest, 80, Hungary 1923
ELFTMAN, DR. HERBERT, 407 Park Ave., Leonia, N. J. 1926
ELTON, CHARLES, Bureau of Animal Populations, Oxford, England 1931
ENDERS, DR. ROBERT K., Edward Martin Biological Laboratory, Swarthmore, Penna. 1924
ENGELS, DR. WILLIAM L., Dept. Zoology, Univ. N. C., Chapel Hill, N. C. 1930
ENGLER, CARL H., 1233 Essex St., San Diego, Calif. 1942

ENGLISH, DR. PENNOYER F., Dept. Zoology, State College, Penna. 1922
ERICKSON, DR. ARNOLD B., Div. Econ. Zoology, Univ. Minn., St. Paul, Minn. 1938
ERLUND, OTHEIL JUSTUS, Box 210, College Station, Texas. 1942
ERRINGTON, DR. PAUL L., Insectary, Iowa State College, Ames, Iowa. 1933
EVANS, DR. FRANCIS COPE, Dept. Biology, Haverford College, Haverford, Penna. 1944
EVANS, DR. THOMAS HORACE, 350 South Main St., Freeport, N. Y. 1935
EWING, DR. H. E., U. S. Natl. Mus., Washington 25, D. C. 1923
FALKENBACK, CHARLES H., Amer. Mus. Nat. Hist., New York 24, N. Y. 1941
FARGO, WILLIAM G., 506 Union St., Jackson, Mich. 1928
FAUTIN, REED W. (Inactive) 1941
FICHTER, SGT. EDSON HARVEY, JR., 945 N. National, Springfield, Mo. 1940
FILLEY, OLIVER D., Bernardsville, N. J. 1930
FINDLEY, JAMES S., 2645 Fairmount Blvd., Cleveland Heights, Ohio. 1944
FINLEY, WILLIAM L., Box 910, Route 10, Portland 2, Ore. Charter
FISHER, EDNA M., 2410 Fulton St., Berkeley, Calif. 1928
FISHER, DR. HARVEY I., Dept. Zoology, Univ. Hawaii, Honolulu, T. H. 1942
FITCH, DR. HENRY SHELDON, Rt. 1, Medford, Ore. 1933
FITZWATER, WILLIAM, 178 Prospect Park West, Brooklyn, N. Y. 1941
FLAIM, FRANCIS R., 4 Lester Ave., San Jose 10, Calif. 1939
FLETCHER, JOHN F. S., Dimock, Penna. 1940
FOLK, G. EDGAR, JR., 426 Mt. Auburn St., Cambridge 38, Mass. 1945
FOLLANSBEE, G. L., Andover 7, Mass. 1940
FORBES, ALAN G., Box 402, Winterhaven, Calif. 1943
FORBES, WILLIAM C., 721 Ohio St., Ashland, Ohio. 1944
FOX, ADRIAN CASPER, c/o Mrs. Nels Fasen, Leeds, N. D. 1935
FRASER, DR. CHARLES M., Univ. British Columbia, Vancouver, B. C. 1921
FREEMAN, ROBERT M., R. 5, Laurel, Miss. 1940
FRICKE, REINHOLD L., Carnegie Museum, Pittsburgh, Penna. 1932
FROST, WILFRED T., 624 Dakota Ave., Medford, Ore. 1937
FRUM, W. GENE, 425 High St., Morgantown, W. Va. 1941
FRY, WILLIAM W., 148 Carroll St., St. Louis, Mo. 1933
FULTON, HAROLD, JR., 35 W. 9th St., New York, N. Y. 1941
FULTON, DR. JOHN F., Laboratory of Physiology, 333 Cedar St., New Haven, Conn. 1939
FURLONG, E. L., Calif. Inst., Tech., Pasadena, Calif. 1925
GABRIELSON, DR. IRA N., U. S. Fish and Wildlife Service, Washington 25, D. C. Charter
GAILLARD, STEPHEN L., 9 Lee Place, Bronxville 8, N. Y. 1945
GALBREATH, EDWIN CARTER, P. O. Box 1024, Springfield, Ill. 1941
GARDNER, ENS. MARSHALL CLOSSON, U. S. Fish & Wildlife Serv., Washington 25, D. C. 1944
GASHWEILER, JAY S., Maine Wildlife Research Unit, Univ. Maine, Orono, Maine 1942
GATES, DR. WM. H., Dept. Zoology, State University, University, La. 1930
GAUGHRAN, GEORGE R. L., 312 Lehigh Ave., Palmerton, Penna. 1941
GAVIN, ANGUS, Eskimo Point, via Churchill, Manitoba, Canada 1942
GAZIN, DR. C. LEWIS, U. S. National Museum, Washington 25, D. C. 1931
GEIST, OTTO W., P. O. Box 1092, Fairbanks, Alaska 1931
GENSCH, ROBERT, Lake States Forest Exp. Station, University Farm, St. Paul, Minn. 1938
GEORGE, DR. IRA D., Dept. Zoology, Louisiana State Univ., Baton Rouge, La. 1939
GERSTELL, DR. RICHARD, Pennsylvania Game Comm., Harrisburg, Penna 1940
GHIGI, PROF. ALESSANDRO, Dept. Zoology, Univ. Bologna, Bologna, Italy 1926
GIFFORD, CLAY L., 253 E. Greene St., Waynesburg, Penna. 1939
GILBERT, DR. PERRY W., Dept. Zoology, Cornell Univ., Ithaca, N. Y. 1938
GILLETTE, EDNA M., Peabody Museum Library, Yale Univ., New Haven, Conn. 1930
GILLMAN, DR. JOSEPH, Medical School, Univ. Witwatersrand, Johannesburg, South Africa 1942
GILMORE, DR. RAYMOND M., Room 57A, U. S. Natl. Mus., Washington 25, D. C. 1926

GLAZENER, WM. CALEB, Falfurrias, Tex. 1940
GLOYD, DR. HOWARD KAY, Chicago Acad. Sci., 2001 N. Clark St., Chicago, Ill. 1922
GOBLE, DR. FRANS CLEON, Research Center, Delmar, N. Y. 1941
GOIN, MRS. OLIVE BOWN, Dept. Biology, Univ. Florida, Gainesville, Fla. 1935
GOLDMAN, MAJ. E. A., U. S. Fish & Wildlife Service, Washington 25, D. C. Charter
GOLDMAN, LUTHER C., Bitter Lake Refuge, Box 7, Roswell, N. Mex. 1937
GOODRUM, PHIL, U. S. Fish & Wildlife Service, Glenn Bldg., Atlanta 3, Ga. 1939
GOODWIN, GEORGE G., Amer. Mus. Nat. Hist., New York 24, N. Y. 1921
GORDINIER, E. J., 519 Clifford St., Lansing, Mich. 1944
GORDON, DR. KENNETH, Oregon State College, Corvallis, Oregon 1936
GOSLIN, ROBERT, 316 Wilson Ave., Columbus, Ohio 1931
GRANT, CLEVELAND P., 245 Davis St., Mineral Point, Wisc. 1926
GRANT, PFC. WM. J., ASN 42026482, Cornell Univ. Medical College, 1300 York Ave., N. Y. 21, N. Y. 1944
GRAY, A. E., 1912 N. W. 21st St., Oklahoma City, Okla. 1924
GRAY, J. A., JR., 4209 Idaho St., San Diego, Calif. 1938
GREEN, MORTON, 100 Woodruff Ave., Brooklyn, N. Y. 1941
GREENHALGH, CLIFTON M., Kanab, Utah 1941
GREGORY, DR. JOSEPH T., Mus. Paleo., Univ. Mich., Ann Arbor, Mich. 1938
GREGORY, S. S., JR., Box N., Winnetka, Ill. 1927
GREGORY, DR. WILLIAM K., Amer. Mus. Nat. History, New York 24, N. Y. Charter
GRIFFIN, DR. DONALD R., Biol. Laboratory, Harvard Univ., Cambridge, Mass. 1929
GRIMM, WILLIAM C., Box 424, Linesville, Penna. 1942
GRINNELL, MRS. JOSEPH, 2737 Forest Ave., Berkeley 5, Calif. 1923
GROSJEAN, MRS. RAY O., 1815 Wells St., Fort Wayne, Ind. 1942
GROSSENHEIDER, RICHARD P., (Inactive) 1941
GUENTHER, STANLEY E., Hunters, Wash. 1942
GUNDERSON, HARVEY L., Gary, Minn. 1943
GUNTER, GORDON, Game, Fish & Oyster Comm., Rockport, Tex. 1941
GUTHRIE, DR. MARY J., Lefevre Hall, Univ. Mo., Columbia, Mo. 1930
GYLDENSTOLPE, COUNT NILS, Naturhistbriska Riksmuseum, Stockholm 50, Sweden. Charter
HAAG, PROF. WILLIAM G., Fair Haven Rd., Rumson, N. J. 1936
HADSALL, DR. LEO F., Fresno State College, Fresno, Calif. 1936
HAECKER, HAROLD H., Box 1317, Sacramento 7, Calif. 1936
HAENISCH, O. CHARLES, Box 4193, College Station, Tex. 1945
HAHN, HENRY C., P. O. Box 366, Kerrville, Tex. 1940
HALL, DR. E. RAYMOND, Mus. Nat. Hist., Univ. Kans., Lawrence, Kans. 1923
HALLER, KARL (Inactive) 1938
HALLORAN, ARTHUR FRANKLIN, P. O. Box 1032, Yuma, Ariz. 1934
HAMERSTROM, MRS. FRANCES, 235 AAF, B.U., Biggs Field, El Paso, Texas 1938
HAMILTON, DR. W. J., JR., Dept. Zoology, Cornell Univ., Ithaca, N. Y. 1924
HAMMOND, MERRILL C., Upham, N. D. 1941
HAMPE, IRVING E., 5559 Ashbourne Rd., Halethorpe P. O., Baltimore 27, Md. 1936
HANDLEY, C. O., U. S. Fish & Wildlife Service, Blacksburg, Va. 1938
HANDLEY, CHARLES OVERON, JR., Blacksburg, Va. 1942
HANSON, H. GORDON, Woodward, Okla. 1941
HARDY, DR. ROSS, Dixie College, St. George, Utah 1938
HARGRAVE, LYNDON L., Benson, Ariz. 1942
HARPER, DR. FRANCIS, 224 Chester Rd., Swarthmore, Penna. Charter
HARRIS, VAN. T., 905 Middlebury St., Elkhart, Ind. 1940
HARRISON, GEORGE L., 1520 Locust St., Philadelphia, Penna. Charter
HARTMAN, PROF. CARL G., Dept. Zoology, Univ. Illinois, Champaign, Ill. 1921
HATFIELD, DR. DONALD M., Chicago Academy of Sciences, Chicago, Ill. 1933
HATT, DR. ROBERT T., Cranbrook Institute of Science, Bloomfield Hills, Mich. 1921

HATTER, JAMES, 4042 W. 11th Ave., Vancouver, B. C., Canada 1945
HAUGEN, DR. ARNOLD O., Swan Creek Wildlife Exp. Sta., Allegan, Mich. 1937
HAVEN, HERBERT M. W., 500 Forest Ave., Portland, Maine ..... Charter
HAVERS, DONALD P., 131 Warm Springs Ave., Boise, Idaho 1945
HAWBECKER, A. C., 228 So. H. St., Madera, Calif. 1937
HAWKINS, ARTHUR S., Rt. 1, Box 322, Amarillo, Tex. 1935
HAYNE, DON, Dept. Zoology, Michigan State College, East Lansing, Mich. 1933
HAYNER, PROF. J. CLIFFORD, New York Med. School, 20 East 106th St., New York 29, N. Y. 1945
HAYWARD, DR. C. LYNN, Dept. Zool., B. Y. U., Provo, Utah 1938
HEADSTROM, BIRGER RICHARD, 1407 Commonwealth Ave., Brighton, Mass. 1942
HECHT, MAX K., 178 Amboy Street, Brooklyn, N. Y. 1943
HECK, PROF. DR. LUDWIG, Budapesterstr. 9, Berlin W 62, Germany 1928
HEILNER, VAN CAMPEN, 17 Battery Place, New York, N. Y. 1928
HEIT, WILLIAM S., 214 Stimson, Cornell Univ., Ithaca, N. Y. 1940
HELME, ARTHUR H., 223 Bayview Terrace, Port Jefferson, N. Y. ..... Charter
HENDERSON, WALTER C., 805-16 Ave. N. E., St. Petersgurg 4, Fla. ..... Charter
HENDRICKSON, ALBERT PRESTON, JR., 2633 Piedmont Ave., Berkeley, Calif. 1941
HENDRICKSON, DR. GEORGE O., Dept. Zoology and Entomology, Iowa State College, Ames, Iowa 1937
HENN, DR. ARTHUR W., Carnegie Museum, Pittsburgh, Penna. 1930
HENRY, WILBUR V., Route 12, Box 878, Los Altos, Calif. 1944
HEPPENSTALL, CAROLINE A., 1217 Heberton St., Pittsburgh, Penna. 1941
HEPTNER, DR. VLADMIR G., Mal. Vusowsky 3, KV 2, Moskva 28, USSR 1932
HERING, DR. PAUL E., Southern College of Pharmacy, Atlanta, Ga. 1930
HERPICH, FRED. C., 491 Ridge Rd., Hamden, Conn. 1930
HERSHKOVITZ, PHILIP, Room 57A, U. S. Natl. Mus., Washington 25, D. C. 1932
HESSE, CURTIS J., Box 288 F. E., College Station, Tex. 1931
HESSELSCHWERDT, ROBERT E. (Inactive) 1941
HIBBARD, DR. CLAUDE W., Mus. Nat. Hist., Univ. Kans., Lawrence, Kans. 1932
HICKIE, MAJ. PAUL F. (Inactive) 1931
HILDEBRAND, HENRY H., Mus. Nat. Hist., Univ. Kans., Lawrence, Kans. 1942
HILDEBRAND, MILTON, 500 Coventry Rd., Berkeley, Calif. 1941
HILL, DR. JOHN E., Dept. Mammals, Amer. Mus. Nat. Hist., New York 24, N. Y. 1930
HINSHAW, THOMAS D. (Inactive) 1926
HINTON, M. A. C., British Museum of Nat. Hist., London, Sw. 7, England 1930
HITCHCOCK, DR. HAROLD B., Dept. Biology, Middlebury College, Middlebury, Vt. 1940
HJERSMAN, HENRY ARTHUR, 4432 52nd Ave. N.E., Seattle 5, Wash. 1942
HODGES, CHARLES H., JR., 135 Kenwood Rd., Grosse Pointe, Mich. 1927
HOFFMEISTER, DR. DONALD F., Mus. Nat. Hist. Univ. Kans., Lawrence, Kans. 1938
HOLDEN, GUERDON S., 8907 Lake Shore Blvd., Cleveland, Ohio 1937
HOLDENRIED, ROBERT, Hooper Foundation, U. C. Medical Center, San Francisco, Calif. 1940
HOLLISTER, MABEL P., 1819 Ontario Place, N. W., Washington 9, D. C. 1925
HOLMAN, JOHN P., Fairfield, Conn. 1921
HOLT, ERNEST G., 2000 F. St., N. W., Washington 6, D. C. ..... Charter
HOOPER, DR. EMMET T., Mus. Zool., Univ. Michigan, Ann Arbor, Mich. 1934
HORN, EVERETT E., 332 Giannini Hall, Berkeley 4, Calif. 1938
HORRING, H., Mag. Scient., Zoologisk Museum, Copenhagen, Denmark 1924
HORSFALL, R. BRUCE, Route #2, Fairport, N. Y. ..... Charter
HOSLETT, DR. SHERMAN A., 701 5th Ave., Decorah, Iowa 1932
HOSLEY, DR. NEIL W., Univ. Conn., Storrs, Conn. 1933
HOSTETTER, DR. D. RALPH, Eastern Menonite School, Harrisonburg, Va. 1939
HOUSE, E. J., Schenley Apts., 5th Ave., Pittsburgh, Penna. 1926

HOWARD, JOHN K. (Inactive) 1928
HOWARD, WALTER E., MAC, OCS, Class 21, Carlisle Barracks, Penna. 1941
HOY, DR. WILLIAM E., Dept. Biology, Univ. S. C., Columbia, S. C. 1922
HOYT, J. SOUTHGATE Y., 820 W. 3rd St., Williamsport 15, Penna. 1942
HUBBACK, THEODORE R., Federated Malay States 1922
HUBBARD, DOUGLAS H., 18 So. 13th St., San Jose 12, Calif. 1941
HUESTIS, DR. R. R., Dept. Zoology, Univ. Ore., Eugene, Ore. 1927
HUEY, LAURENCE M., Mus. Nat. Hist., Balboa Park, San Diego 1, Calif. ..... Charter
HUGHES, GWLADYS, F., c/o Mrs. Fred H. Jones, 12 W. Market St., Danville, Penna. 1937
HUGHES, THOMAS H., JR., A. & I. State College, Nashville 8, Tenn. 1941
HUNGATE, PROF. J. W., State Normal School, Cheney, Wash. 1925
HURST, WILLIAM D., Manila, Utah 1944
HUTCHINSON, ARTHUR E., FAORP-FARTC, Camp Roberts, Calif. 1940
INGLES, DR. LLOYD G., Fresno State College, Fresno, Calif. 1939
INGRAM, DR. WILLIAM M., Dept. Zoology, Mills College, Oakland 13, Calif. 1940
INKLEY, SCOTT R., 5124 Spencer Rd., South Euclid, Ohio 1936
JACKSON, PROF. C. F., Dept. Zoology, Univ. New Hampshire, Durham, N. H. 1921
JACKSON, DR. HERBERT W., Virginia Polytechnic Inst., Blacksburg, Va. 1936
JAEGER, PROF. EDMUND C., Junior College, Riverside, Calif. 1921
JAMESON, EVERETT W., JR., 179 Highland Ave., Buffalo, N. Y. 1942
JAMISON, STANTON L., Box 317, College Station, Pullman, Wash. 1944
JELLISON, DR. WILLIAM L., Hamilton, Mont. 1931
JENKINS, HUBERT O., 2116 3rd Ave., Sacramento, Calif. 1936
JENKINS, JAMES H., Box 142, Twinsburg, Ohio 1940
JENNER, WILLIAM ALEXANDER (Inactive) 1940
JEPSEN, DR. GLENN L., Univ. Dept. Geology, Princeton, N. J. 1930
JESSEMAN, WINSTON (Inactive) 1940
JEWETT, STANLEY G., 1404 Bidwell St., S. E., Portland, Ore. ..... Charter
JOHNSON, DR. DAVID H., 7305 Princeton Ave., College Park, Md. 1933
JOHNSON, JULIUS M., 324 Laurel St., Sarasota, Fla. 1924
JOHNSON, MAYNARD S., New Holland, N. C. 1929
JOHNSON, DR. MURRAY L., 1520 E. 28th St., Baltimore 18, Md. 1936
JOHNSON, PAUL B., 1673 Columbia Rd., N. W., Washington 9, D. C. 1924
JONES, DR. GORDON W., "Elwood" Farm, Parker, Va. 1934
JONES, S. PAUL, 509 West Ave., North, Waukesha, Wisc. 1929
JONES, VICTOR E., Univ. Idaho, So. Branch, Pocatello, Idaho 1941
JOPSON, DR. HARRY, 268 Montgomery Ave., Haverford, Penna. 1938
JURICA, DR. EDMUND J., St. Procopius College, Lisle, Ill. 1943
KAGAN, DR. MARTIN, Box 177, Mercerville, N. J. 1945
KALMBACH, E. R., U. S. Fish & Wildlife Service, 546 Custom House, Denver 2, Colo. 1925
KASCHKAROV, DR. D., Universitetskaja Naberejnaja, 7/9 Kv. 13, Leningrad, SSSR 1929
KEAYS, J. E., 328 St. George St., London, Ontario 1924
KELKER, PROF. GEORGE H., School of Forestry, Utah Agric. College, Logan, Utah 1932
KELLOGG, DR. A. REMINGTON, U. S. Natl. Museum, Washington 25, D. C. ..... Charter
KENDEIGH, DR. S. CHARLES, 204 Vivarium Bldg., Wright and Healey St., Champaign, Ill. 1937
KENWORTHY, WALTER J., 424 Knorr St., Philadelphia, Penna. 1940
KERN, CHARLES W., Griffith Park Zoo, Box 284, Los Angeles 27, Calif. 1944
KING, DR. HELEN D., Wistar Institute of Anatomy, 36th & Woodland Ave., Philadelphia 4, Penna. 1930
KING, JOHN ARTHUR, 653 University Place, Grosse Pointe, Mich. 1939
KINNEY, WARREN W., Lee's Hill Farm, New Vernon, P. O. Morristown, N. J. 1944
KIRKWOOD, FRANK C., Baldwin, Baltimore Co., Md. ..... Charter
KLINGENBERG, LT. COL. PAUL J., 206 Turnbull, Oklahoma City 10, Okla. 1938

Koehler, Hans V., Koehler Road, Boonton, N. J. 1944
Koford, Lt. Carl B., 2661 Virginia St., Berkeley, Calif. 1938
Kolb, Charles H., Jr., 5021 Midwood Ave., Baltimore 12, Md. 1938
Komarek, E. V., Birdsons Plantation, Thomasville, Ga. 1928
Koster, Louis J., East Greenbush, R. R., N. Y. 1945
Krutzsch, Philip H., 1536 31st St., San Diego 2, Calif. 1944
Kuroda, Dr. Nagamichi, Fukuyoshi Cho, Akasaka, Tokyo, Japan ..... Charter
Landberg, Robert L., 81st General Hospital, Barracks #3, Camp White, Medford, Ore. 1927
Landon, C. R., P. O. Box 1941, San Antonio, Tex. 1944
Landwer, Dr. M. Frederic, Biology Dept., Texas Tech., Lubbock, Texas 1933
Lane, F. W., 118 Evelyn Ave., Ruislip, Middx, England 1942
Lane, Dr. H. H., Snow Hall, Univ. Kans., Lawrence, Kansas ..... Charter
Langenbach, John R., 415 Hastings St., So. Williamsport, Penna. 1938
Langstroth, James H., P. O. Box 800, Silver City, N. Mex. 1926
Langworthy, Dr. O. R., Johns Hopkins Hospital, Baltimore, Md. 1928
Larrison, Earl J., 1420 North 48th Street, Seattle 3, Wash. 1941
Lawrence, Barbara, Mus. Comp. Zool., Cambridge, Mass. 1933
Lay, Dan W., Game, Fish, and Oyster Comm., Austin, Tex. 1938
Lay, George B., 18 Pleasant St., Hopkinton, Mass. 1942
Lebrecht, Robert Jay, 825 West End Ave., New York, N. Y. 1939
Leedy, Daniel, Ohio Wildlife Research Unit, Columbus, Ohio 1939
Lehmann, Valgene W., c/o Mrs. John Jacyek, Bellville, Tex. 1938
Leister, Dr. C. W., N. Y. Zool. Park, Bronx, N. Y. ..... Charter
Leopold, Dr. Aldo, 424 University Farm Place, Madison 6, Wis. ..... Charter
Leraas, Dr. Harold J., RR # 1, Ann Arbor, Mich. 1932
Leser, Felix A., Saranac Lake, N. Y. 1938
Lewis, John B., Seward Forest, Triplett, Va. 1926
Lewis, Dr. Nolan D. C., New York State Psychiatric Inst., New York, N. Y. 1927
Lightfoot, William C., Hunter Hot Spring Hotel, Lakeview, Ore. 1945
Linduska, Joseph P., Bur. Ent. & Plant Quar., Box 3391, Orlando, Fla. 1942
Linsdale, Dr. Jean M., Jamesburg Route, Monterey, Calif. 1921
Little, Dr. Clarence C., Bar Harbor, Me. 1927
Little, Luther, 2305 Brentford Rd., San Marino 9, Calif. ..... Charter
Livezey, Robt. L., Dept. Zoology, Cornell Univ., Ithaca, N. Y. 1945
Livingston, Morton, Apt. 15, 2942 Franklin St., San Francisco 23, Calif. 1941
Llewellyn, Leonard M., U. S. Fur Animal Exp. Station, Saratoga Spgs., N. Y. 1941
Lloyd, Hoyes, 582 Mariposa Ave., Rockcliffe Park, Ottawa, Ontario, Canada ..... Charter
Longhurst, Dr. Wm. M., Box 5500 Sonoma Hwy., Napa, Calif. 1940
Loshakoff, Samuel J., 1964 Davidson Ave., Apt. 4c, Bronx 53, N. Y., N. Y. 1942
Loukashkin, Anatole S., 2424 Fulton St., San Francisco, Cqlif. 1941
Lovell, Prof. Harvey B., Belknap Campus, Univ. Louisville, Louisville, Ky. 1934
Lowery, George H., Louisiana State Univ., University, La. 1936
Ludeman, Capt. B. E. (Inactive) 1940
Luttringer, Leo A., Jr., Board of Game Commissioners, Harrisburg, Penna. 1932
Lyman, Rufus A., Jr., 16495 21st St., Lincoln, Nebr. 1940
McCabe, Britton Charles, Springfield College, Springfield, Mass. 1940
McCabe, Francis R. (Inactive) 1937
McGregor, Prof. James H., Columbia Univ., New York 27, N. Y. 1927
McGuire, Edward, Amer. Mus. Nat. Hist., New York 24, N. Y. 1941
McIlhenny, Edward A., Avery Island, La. ..... Charter
McIntosh, William B., 414 Oakridge Blvd., Lynchburg, Va. 1942
McKean, John W., 3619 S.E. Francis St., Portland 2, Ore. 1945
McKee, Guy William, 121 W. 2nd Ave., South Williamsport, Penna. 1942

McLain, Robert B., 308 N. Primrose Ave., Monrovia, Calif. ..... Charter
McLean, Donald D., 101 E. St. James St., San Jose 12, Calif. 1938
McLulich, Dr. Duncan A., 144 Mavety St., Toronto, Ontario 1941
McManus, Reid, Jr., Memramcook, New Brunswick, Canada 1944
MacMullan, R. A., Garden City, Mich. 1944
McMurry, Frank B., P. O. Box 1032, Yuma, Ariz. 1936
Macnab, Prof. James Arthur, Dept. Biology, Linfield College, McMinnville, Oregon 1941
Maas, John C., Box 188, LaGrange, Ky. 1945
Maildin, Capt. James D. (Inactive) 1941
Maldonado K., Prof. Manuel, Mus. Nat. Hist., Univ. Kans., Lawrence, Kans. 1945
Mann, F., Sr., Guillermo, Calle Eusebio Lillo 2157, Los Leones, Santiago, Chile ... 1945
Manning, Thomas Henry, 80 Arlington Ave., Ottawa, Ont., Canada 1944
Mansfield, George S., P. O. Box 385, Atascadero, Calif. 1942
Manville, Lt. Richard H. (Inactive) 1939
Manweiler, Jack, Office of Labor WFA, P.O. Box 338, Shaffer, Calif. 1936
Marcotte, L'Abbe Leon, ptre., Seminaire, St. Charles, Sherbrooke, Quebec, Canada 1925
Markley, Merle H., 404 B Street, N. E., Washington, D. C. 1941
Marks, Eugene M., 2203 Fillmore Ave., Buffalo 14, N. Y. 1942
Marsh, Ens. Ernest George, Jr. (Inactive) 1941
Marshall, Dr. William H., Div. Ento. & Econ. Zool., Univ. Farm, St. Paul 8, Minn. 1936
Martinez, Prof. Liborio, Mar de China No. 14, Tacuba, D. F., Mexico 1944
Mather, Deane W., U. S. F. S., Tell City, Ind. 1930
Mead, Grayson, Texas Tech., Lubbock, Tex. 1931
Medcalf, Robert, 2606 SE 81st Ave., Portland 6, Ore. 1944
Merkle, Jess M., Route 3, Box 336A, Madera, Calif. 1945
Merrill, Howard A., Storrs, Conn. 1938
Merry, Dr. Katherine E., Mus. Zool., Univ. Mich., Ann Arbor, Mich. 1944
Metcalf, Prof. Z. P., N. C. State College, Raleigh, N. C. ..... Charter
Meyer, Gardiner Howland, Shore Acres, Bayside, L. I., N. Y. 1939
Miller, Dr. Alden H., Mus. Vert. Zool., Berkeley 4, Calif. 1930
Miller, Frederic W., 2911 Faxine Pl., Dallas, Tex. 1920
Miller, Dr. Loye H., University of California, Los Angeles 24, Calif. ..... Charter
Miller, Richard G., 12 Oakmont Dr., Los Angeles 24, Calif. 1936
Miller, Dr. Robert C., Calif. Acad. Sci., San Francisco 18, Calif. 1938
Miller, Prof. Shirley P., Institute of Anatomy, University of Minn., Minneapolis, Minn. ..... Charter
Miller, Thomas, 1809 Bushnell Ave., South Pasadena, Calif. 1941
Mills, Dr. Herbert R., 706 Franklin St., Tampa 2, Fla. 1941
Mills, Robert H., 2466 Medary Ave., Columbus 2, Ohio 1942
Mirguet, Joseph C., 104 Platt St., Rochester, N. Y. 1928
Mitchell, Kenneth A., 3582 Washington Blvd., Cleveland, Ohio 1940
Mohr, Dr. Carl Otto, 1113 W. John St., Champaign, Ill. 1927
Mohr, Charles E., The Academy of Nat. Sciences, Philadelphia 3, Penna. 1932
Mohr, Erna W., Zoologische Museum, Hamburg, Germany 1928
Mondolfi, Egardo, Apartado 725, Caracas, Venezuela 1944
Monson, Gale, 2728 E. Helen St., Tucson, Ariz. 1935
Montgomery, Robert D. (Inactive) 1936
Moody, Dr. Paul A., Dept. Zoology, Williams, Science Hall, Burlington, Vt. 1923
Moore, A. W., 673 E. Main St., Hillsboro, Ore. 1921
Moore, Clifford B., 94 Olmsted Dr., Springfield, Mass. 1942
Moore, George C., Dept. Conservation, Montgomery, Alabama 1941
Moore, Martha, 27 Eastover Ct., Louisville, Ky. 1942
Moore, Paul J., Ohio Wildlife Res. Sta., Ohio State Univ., Columbus, O. 1944
Moore, Robert T., R. R. #1, Box 28A, Pasadena, Calif. 1926

Mori, Tamezo, Preparatory Dept., Keijo Imperial Univ., Seoul, Korea 1928
Mosby, Dr. Henry S., 220 Madison St., Lynchburg, Va..... 1937
Moseley, Prof. E. L., State University, Bowling Green, Ohio.....Charter
Mossman, Dr. Harland W., Science Hall, Univ. Wisconsin, Madison, Wis..... 1930
Murdock, Mrs. Donald R., Lindbergh Ave. & McLeon St., Washington Court House, Ohio..... 1930
Murdy, Horatio W., 390 Hixville Rd., No. Dartmouth, Mass..... 1944
Murie, Dr. Adolph, San Carlos, Ariz..... 1924
Murie, O. J., Jackson, Wyo.....Charter
Murray, Dr. Leo T., Box 51 FE, A&M College, College Station, Tex..... 1936
Musgrave, Dr. John K., 350 Parkway Drive, Pittsburgh 16, Penna..... 1937
Nagel, Otto, RFD #1, Sigourney, Iowa..... 1945
Neil, Richard W. (Inactive)..... 1940
Nelson, Arnold L., 3256 Van Hazen St., N. W., Washingron 15, D. C..... 1932
Nelson, Bernard A., 516 LaBree Ave., N., Thief River Falls, Minn..... 1944
Nelson, Dr. Theodora, 315 East 68th St., New York, N. Y..... 1929
Netting, M. Graham, Carnegie Museum, Pittsburgh 13, Penna..... 1934
Nicéfero, Maria Hermano, Instituto de La Salle, Bogota, Colombia, S. A..... 1943
Nichol, A. A., 1312 S. Genesee Ave., Los Angeles 35, Calif..... 1935
Nichols, David G., 116 9th St., Garden City, N. Y..... 1936
Nichols, John T., Amer. Mus. Nat. Hist., New York 24, N. Y.....Charter
Nichols, Walter F., 120 S. San Rafael Ave., Pasadena, Calif..... 1939
Nicholson, Dr. A. J., 602 E. 45th St., Austin, Tex..... 1935
Noren, Carl R., 7637 Dale Ave., St. Louis, Mo..... 1942
Norris, Russel T., R. 7, Butler, Penna..... 1939
O'Connell, Harold J., #1 St. James Place, Dongan Hills, Staten Is., N. Y..... 1939
O'Donoghue, Prof. Chas. H., Dept. Zoology, Univ., Edinburgh, Scotland.....Charter
Oehler, Charles M., 802 Delhi Ave., Cincinnati, O..... 1942
Ognev, Dr. S. I., Ul. Granovskogo 4, KV. 6, Moskva, USSR..... 1925
Ohlman, Robert G., 30 S. Clinton St., Poughkeepsie, N. Y..... 1944
Okkelberg, Prof. Peter, 1220 Fair Oaks, Ann Arbor, Mich.....Charter
Oliver, John P., Dept. Biol., Walla Walla College, College Place, Wash..... 1945
Olson, Lt. Andrew C., 4412 Campus Ave., San Diego 3, Calif..... 1941
Orange, Miss Jeanette, 763 Eastern Parkway, Brooklyn 13, N. Y..... 1937
Orcutt, Donald R. (Inactive)..... 1941
Orr, Dr. Robert T., Calif. Acad. Sci., Golden Gate Park, San Francisco 18, Calif... 1931
Orwoll, Harold S. (Inactive)..... 1937
Osborn, Hon. Chase S., c/o Miss A. L. Lynch, 231 Ridge St., Sault Ste. Marie, Mich. 1925
Osgood, Frederick L., Jr., 17 Charles St., Rutland, Vt..... 1933
Osmer, Thomas L. G. (Inactive)..... 1939
Ostenson, Burton, T. (Inactive)..... 1933
Pack, Arthur N., American Nature Assoc., 1214 16th St., N.W., Washington 6, D. C..... 1929
Packard, Lt. Fred M., 34 Randolph St., Passaic, N. J..... 1940
Palmer, Dr. E. Laurence, Fernow Hall, Ithaca, N. Y..... 1927
Palmer, L. J., c/o Alaska Indian Service, Juneau, Alaska..... 1927
Palmer, Dr. Ralph S., Dept. Zool., Vassar Coll., Poughkeepsie, N. Y..... 1938
Palmer, Dr. T. S., 1939 Biltmore Street, N. W., Washington 9, D. C.....Charter
Parker, Dr. George H., 16 Berkeley Street, Cambridge 38, Mass.....Charter
Parker, Harry C., 4284 Jackdaw St., San Diego 3, Calif..... 1927
Partch, Max L., 613 Prairie St., Columbus, Wisc..... 1938
Pearce, John, 643 Park Sq. Bldg., Boston, Mass..... 1931
Pearson, Dr. Allen M., P. O. Box 1031, Alabama Polytechnic Institute, Auburn, Alabama..... 1938
Pearson, Oliver P., 210 West Mermaid Lane, Chestnut Hill, Philadelphia, Penna.. 1937

PEQUEGNAT, WILLIS E., Dept. Zool., Pomona College, Claremont, Calif. 1941
PETERS, JAMES L., Lane End, Harvard, Mass. ..... Charter
PETERSON, LIVEN ADAM, JR., 904 South 4th Ave., Virginia, Minn. 1942
PETERSON, RANDOLPH L., Box 254, F. E., College Station, Texas 1940
PETRIDES, LT. GEORGE A., U. S. Navy Preflight School, Athens, Ga. 1944
PETTINGILL, DR. O. S., JR., Dept. Zoology, Carlton College, Northfield, Minn. 1936
PETTIT, LINCOLN C., 59 Harrison Ave., Baldwin, L. I., N. Y. 1941
PFLUEGER, ALBERT, Box 1328, North Miami, Florida 1939
PHILLIPS, FRANK, F. P. Ranch, Route 4, Bartlesville, Okla. 1926
PHILLIPS, JOHN M., 2227 Jane Street, Pittsburgh, Penna. ..... Charter
PICKWELL, DR. GAYLE B., State College, San Jose 14, Calif. 1926
PLOSS, WILLIAM R., 422 Washington Highway, Snyder, N. Y. 1941
POHLE, DR. HERMANN, Invalidenstrasse 43, Berlin, N.4, Germany 1928
POOLE, E. L., Reading Public Museum, Reading, Penna. 1922
POPE, FERGUS B., P. O. Box 306, Morristown, N. J. 1944
PORRO, THOMAS J., 718 Medical Arts Bldg., Tacoma, Wash. 1931
PRATT, DR. HAROLD P., Box 99, Soil Cons. Serv., Montrose, Colo. 1941
PRATT, LORING W., 716 Crescent Parkway, Westfield, N. J. 1941
PREBLE, EDWARD A., 3027 Newark St., Washington 8, D. C. ..... Charter
PREBLE, NORMAN A., Dept. Biology, Ashland College, Ashland, Ohio 1935
PRESNALL, CLIFFORD C., Box 262, Lake Zurich, Ill. 1935
PRIDDY, RALPH B., 24 Manemet Road, Newton Centre, Mass. 1941
PRINCE, SGT. LESLIE A., R. C. A. F., 160 Fern Ave., Toronto, Ontario 1938
PUSHEE, GEORGE F., JR., 1147 No. Pleasant, North Amherst, Mass. 1944
QUIMBY, DON, 4742 Garfield Ave., So., Minneapolis, Minn. 1941
RABB, JOSEPH C., Barco, N. C. 1940
RACEY, KENNETH, 3262 West First Ave., Vancouver, B. C., Canada 1938
RAMSDEN, DR. CHARLES T., 8 y 19, Vista Alegre, Santiago de Cuba ..... Charter
RAND, DR. A. L., National Mus. Canada, Ottawa, Ont. 1933
RASMUSSEN, DR. D. IRVIN, U. S. Forest Service, Forest Service Bldg., Ogden, Utah 1936
REDEKER, J. A. (Inactive) 1942
REED, DR. CHARLES A., Dept. Biology, Reed College, Portland, Ore. 1942
REED, JOSEPH D., 923 Main St., Larned, Kans. 1942
RÉEVES, MARK W., Stockade, Clinton, Conn. 1929
REHN, JAMES A. G., Acad. Nat. Sci., Logan Square, Philadelphia, Penna. ..... Charter
RETT, EGMONT Z., Santa Barbara Mus. Nat. Hist., Santa Barbara, Calif. 1924
RETTIG, RICHARD W., JR., 1723 Edgeley St., Philadelphia, Penna. 1940
REYNOLDS, HAROLD C., Univ., Nebr. State Mus., Lincoln, Nebr. 1944
RICHARDSON, WM. B., P. O. Box 190, Porterville, Calif. 1933
RICHTER, DR. CURT P., Psycho. Lab., Johns Hopkins Hospital, Baltimore, Md. 1924
RIEMER, JULIEUS, Berlinerstr. 163, Berlin-Tempelhof, Germany 1930
RINEY, MRS. BERNICE E., 18492 Crest Ave., Hayward, Calif. 1941
RINEY, THANE ALBERT (Inactive) 1941
RINKER, GEORGE, Mus. of Nat. Hist., Univ. Kans., Lawrence, Kans. 1941
RITER, WILLIAM E., U. S. Fish & Wildlife Serv., Merchandise Mart, Chicago 54, Ill., 1941
ROBERTS, AUSTIN, Transvaal Mus., Pretoria, So. Africa ..... Charter
ROBERTS, H. R., Villa Nova, Penna. 1925
ROBERTS, DR. T. S., Zool. Mus., Univ. Minn., Minneapolis, Minn. ..... Charter
ROBERTSON, HOWARD, 157 Wilton Drive, Los Angeles, Calif. ..... Charter
ROBERTSON, JAMES L., Box 453, Bryan, Tex. 1941
RODECK, PROF. HUGO G., Mus. Univ. Colo., Boulder, Colo. 1939
ROGERS, ALBERT C., Colorado Mus. Nat. Hist., City Park, Denver, Colo. ..... Charter
ROMER, PROF. ALFRED S., Biol. Lab., Harvard Univ., Cambridge, Mass. 1944
ROONEY, JAMES, Route 7, Yakima, Wash. 1941

ROSELLE, ROBERT E., 107 Whitten Hall, Columbia, Mo. 1942
ROSS, ROLAND C., 1820 Bushnell St., South Pasadena, Calif. 1925
ROTH, ADOLPH R. (Inactive) 1937
ROUSE, CHARLES H., Box 1308, Lakeview, Ore. 1938
ROWAN, PROF. WILLIAM, Univ. Alberta, Edmonton, Alberta 1921
ROWLEY, J. S., 424 No. Valencia, Alhambra, Calif. 1928
RUDD, R. L., Mitchell-Silliman Co., Box 150, Salinas, Calif. 1930
RUHE, HERMANN (Inactive) 1930
RUHL, H. D., Game Div. Dept. Conservation, Lansing 13, Mich. 1928
RUSSELL, DR. C. P., National Park Serv., Merchandise Mart, Chicago 54, Ill. 1931
RUSSELL, WARD C., Mus. Vert. Zool., Berkeley 4, Calif. 1930
RUST, HENRY J., Box 683, Coeur d' Alene, Idaho 1922
SANBORN, COLIN C., Chicago Mus. Nat. Hist., Chicago 5, Ill. 1924
SANDERS, DR. EARL, 2369 Pasadena Ave., Long Beach, Calif. 1939
SANDERSON, WILFORD E., R. 107, Albany 4, N. Y. 1927
SAWAYA, DR. PAULO, Dept. Zoologia, Universidade de Sao Paulo, Caixa Postal 2926, Sao Paulo, Brazil 1942
SAWYER, DR. ELIZABETH L., Rockford College, Rockford, Ill. 1936
SCHAEFFER, BOB, 4634 Spruce St., Philadelphia, Pa. 1936
SCHALDACH, WILLIAM, JR., 25 School St., Hanover, N. H. 1941
SCHANTZ, MISS VIOLA S., Apt. 506, 1437 Rhode Island Ave. N. W., Washington 5, D. C. Charter
SCHAUENSEE, RODOLPHE MEYER DE, Devon, Pa. 1931
SCHEFFER, THEODORE H., Puyallup, Wash. Charter
SCHEFFER, DR. VICTOR B., 105 Anderson Hall, Univ. Wash., Seattle, Wash. 1938
SCHERER, LLOYD E., JR., 1513 E. First St., Duluth 5, Minn. 1940
SCHLAIKJER, DR. ERICH M., Dept. Geol., Brooklyn College, Bedford and Ave. H, Brooklyn, N. Y. 1931
SCHMIDT, KARL P., Chicago Mus. Nat. Hist., Chicago 5, Ill. 1925
SCHOLES, ROBERT T., Bushnell, Ill. 1944
SCHORGER, DR. A. W., 168 No. Prospect Ave., Madison, Wisc. 1924
SCHULTZ, DR. ADOLPH H., Dept. Anatomy, Johns Hopkins Med. School, Baltimore 5, Md. Charter
SCHULTZ, DR. C. BERTRAND, Univ. Nebr. State Mus., Lincoln, Nebr. 1934
SCHWARZ, MAX D., 625 Tuxedo Blvd., Webster Groves 19, Mo. 1934
SCOTT, PROF. JOHN W., 1409 Garfield St., Laramie, Wyo. 1925
SCOTT, DR. THOMAS G., Dept. Zoology & Entomology, Iowa State College, Ames, Iowa 1937
SCOTT, DR. WALTER J., Swarthmore College, Swarthmore, Penna. 1933
SCULL, ENS. CHARLES E., JR. (Inactive) 1942
SEALANDER, JOHN A., Wash. Ave. North, Detroit Lakes, Minn. 1941
SEAMANS, ROGER, Fish and Game Service, Montpelier, Vt. 1938
SEFTON, JOSEPH W., JR., San Diego Trust & Savings Bank, San Diego, Calif. 1925
SENSENIG, DR. E. CARL, Dept. Anatomy, Tulane Univ., New Orleans 15, La. 1944
SETON, HENRY, Fairhaven Hill, Concord, Mass. 1924
SETZER, HENRY W., Mus. Nat. Hist., Univ. Kans., Lawrence, Kans. 1945
SEVERAID, JOYE H., Huxley, Iowa 1940
SHADLE, PROF. ALBERT R., Univ. Buffalo, Buffalo 14, N. Y. 1925
SHAMEL, H. H., U. S. Nat. Mus., Washington 25, D. C. 1923
SHARP, DR. WARD M., Red Rock Lakes Natl. Wildlife Refuge, Monida, Mont. 1936
SHAW, CHARLES R., 5601 Cross Second St., Baton Rouge 14, La. 1939
SHAW, DR. WILLIAM T., 1002 Cambridge Ave., Fresno, Calif. Charter
SHEARER, DR. AMON R., Mount Belview, Chambers Co., Tex. 1923
SHEFFIELD, JOHN M., 1872 Monroe Ave., New York 57, N. Y. 1945
SHELDON, W. G., 361 Main St., Hingham, Mass. 1933

SHELFORD, DR. VICTOR E., Vivarium Bldg., Univ. Ill., Champaign, Ill. 1923
SHEPPARD, WALTER B., 1060 Gaylord St., Denver, Colo. 1929
SHERMAN, DR. HARLEY B., 2709 Univ. Court, R. D. #2, Gainesville, Fla. ..... Charter
SHORTRIDGE, CAPT. GUY CHESTER, Kaffrarian Mus., King William's Town, Cape Province, So. Africa 1944
SIBLEY, CHARLES G., 1438 Hawthorne Terrace, Berkeley, Calif. 1942
SIEGLER, HILBERT R., Fish & Game Dept., State House Annex, Concord, N. H. 1937
SIME, PALMER (Inactive) 1936
SIMPSON, DR. GEORGE GAYLORD, Amer. Mus. Nat. Hist., New York 24, N. Y. 1928
SKILLEN, DR. DONALD R., Route 1, Box 65, Pasadena, Calif. 1933
SKINNER, MORRIS F., Frick Laboratories, Amer. Mus. Nat. Hist., New York 24, N. Y. 1941
SLIPP, JOHN W., 1532 N. Anderson St., Tacoma, Wash. 1944
SMILEY, ALBERT K., JR., Mohonk Lake, N. Y. 1932
SMILEY, DANIEL, JR., Mohonk Lake, N. Y. 1931
SMITH, CLARENCE F., 2623 Virginia St., Berkeley 4, Calif. 1936
SMITH, HORACE G., 2918 Lafayette Street, Denver, Colo. ..... Charter
SMITH, MISS NATASHA D., c/o Dr. Rosemary Lippitt, 32 Chestnut Ave., N. Pelham, N. Y. 1940
SMITH, DR. RALPH R., Dept. Zoology, San Jose State College, San Jose 14, Calif. 1941
SMITH, WENDELL P., Wells River, Vt. 1927
SNYDER, L. L., Royal Ontario Mus. Zool., Toronto, Ontario 1921
SOLLBERGER, DWIGHT, Indiana State Teachers College, Indiana, Penna. 1938
SOOTER, CLARENCE A., 402 Hester St., Stillwater, Okla. 1938
SOPER, J. DEWEY, 827 Riverwood Ave., Fort Garry, Winnipeg, Manitoba ..... Charter
SOULEN, MAJ. GARRETT H., Camp Hdq., Camp Bowie, Tex. 1941
SOWERBY, ARTHUR DEC., 34 Lucerne Rd., Shanghai, China ..... Charter
SPAULDING, PROF. M. H., 122 North Bozeman, Bozeman, Montana ..... Charter
SPENCER, DONALD A., 4825 Wadsworth Ave., Wheatridge, Colo. 1928
SPERRY, PROF. ARTHUR B., Kansas Agricultural College, Manhattan, Kans. 1923
SPERRY, CHARLES C., U. S. Fish & Wildlife Serv., 1455 So. Franklin St., Denver 10, Colo. ..... Charter
SPINNER, GEORGE P., 130 Kenney St., Forestville, Conn. 1942
SPRAGUE, DR. JAMES M., Dept. Anatomy, Johns Hopkins Med. School, Baltimore 5, Md. 1937
SPRINGER, STEWART, Box 983, Homestead, Fla. 1936
SPURLOCK, DR. G. M., 905 West Moreland St., Phoenix, Ariz. 1941
STAGER, KENNETH, Los Angeles Mus., Exposition Park, Los Angeles 7, Calif. 1936
STANFORD, JACK A., 553 So. First, Ann Arbor, Mich. 1942
STANFORD, DR. J. S., Utah State Agricultural College, Logan, Utah 1931
STEBLER, ADOLPH M. (Inactive) 1933
STEENBERG, PROF. CARL M., Silene Alle 9, Copenhagen-Soeborg, Denmark 1930
STEGEMAN, DR. LEROY C. (Inactive) 1929
STEINER, CORP. L. D. (Inactive) 1939
STEVENS, LT. JOE THERON, 3828 Unit, 8th S. C., N.T.A.C., Arlington, Tex. 1944
STEVENS, JOSEPH WALTER, 1616 Kerrigan Ave., Union City, N. J. 1944
STEVENSON, LT. JAMES O., 118 No. Birmingham Pl., Tulsa 4, Okla. 1938
STEWART, PHILIP B., 1228 Wood Ave., Colorado Springs, Colo. 1921
STICKEL, WM. H., U. S. Fish & Wildlife Ser., Patuxent Refuge, Bowie, Md. 1941
STILLWELL, JERRY E., 7460 San Benito Way, Dallas, Tex. 1941
STIRTON, DR. R. A., Mus. Paleontology, Berkeley 4, Calif. 1923
STOCK, DR. CHESTER, Calif. Inst. Technology, Pasadena 4, Calif. ..... Charter
STODDARD, HERBERT L., The Hall, Route 1, Tallahassee, Fla. ..... Charter
STONE, HARRY H., P. O. Box 101, Sturbridge, Mass. 1926
STONE, NED, 2418 California St., Berkeley, Calif. 1941

Stoner, Mrs. Dayton, New York State Mus., Albany 1, N. Y. 1945
Storer, Robert W., Mus. Vert. Zool., Berkeley 4, Calif. 1937
Storer, Prof. Tracy I., Div. Zoology, Univ. Calif., Davis, Calif. ..... Charter
Stott, Kenhelm, W., Jr., 1724 Guizot St., San Diego, Calif. 1941
Stout, Thompson M., Frick Lab., Amer. Mys. Nat. Hist., New York, N. Y. 1934
Straus, Dr. William L., Jr., Dept. Anatomy, Johns Hopkins Med. School, Baltimore 5, Md. 1925
Streator, Clark P., 229 Otis St., Santa Cruz, Calif. ..... Charter
Stuewer, Dr. Frederick, Howard City, Mich. 1939
Stullken, Donald E., 5464 Walton St., Chicago, Ill. 1941
Stupka, Arthur, Natl. Park Service, Great Smoky Mtns. Natl. Park, Gatlinburg, Tenn. 1935
Sturgis, Robert S., 81 High St., Winnetka, Ill. 1939
Sturtevant, Miss Mary E., Zoology Dept., Univ. Chicago, Chicago, Ill. 1941
Sumner, E. L., Jr., P. O. Box 188, Menlo Park, Calif. 1926
Sumner, Dr. Francis B., Scripps Institution, La Jolla, Calif. ..... Charter
Svihla, Dr. Arthur, Dept. Zoology, Univ. Wash., Seattle 5, Wash. 1926
Swanson, Dr. Gustav, 5245 No. Sawyer, Chicago 25, Ill. 1935
Swartz, Gordon E., 2280 N. Loring Pl., University Hts., New York, N. Y. 1941
Swindle, Dr. Percy F., 561 N. 15th St., Milwaukee, Wis. 1927
Swynnerton, Maj. Gerald H., Kondoa, Tanganyika Territory, E. Africa 1940
Sykes, Prof. G F., 416 Huntington Ave., Boston, Mass. 1935
Tanner, Prof. Vasco M., Brigham Young Univ., Provo, Utah ..... Charter
Tappe, Donald T., R. R. No. 1, Box 450, Porterville, Calif. 1936
Tate, Dr. George H. H., Amer. Mus. Nat. Hist., New York 24, N. Y. 1924
Taube, Clarence, 1022 Pearl St., St. Joseph, Mich. 1944
Taylor, Dr. Edward H., Dept. Zoology, Univ. Kansas, Lawrence, Kans. 1924
Taylor, Dr. Walter P., 254 Faculty Exchange, College Station, Tex. ..... Charter
Taylor, Wm. Ralph, Mus. Nat. Hist., Univ. Kansas, Lawrence, Kans. 1939
Teachenor, Dix, Box 139, Kansas City, Mo. 1920
Teeters, Robert, 7608 New Second St., Melrose Park, Philadelphia 26, Penna. 1944
Terrell, Harold V. (Inactive) 1942
Terres, John K., 6th Guard Detachment P. T., N. R. T. Pier 90, N. Y., N. Y. 1935
Test, Dr. Frederick H., Dept. Zoology, Univ. Michigan, Ann Arbor, Mich. 1930
Tevis, Lloyd P., Box 1416, Carmel, Calif. 1940
Thomas, Miss Olive E., 339 Arthur St., Liberty, Mo. 1944
Thompson, Ens. Daniel Q., USCGR, U. S. S. Joseph T. Dickman, APA 13, FPO, San Francisco, Calif. 1944
Thomsen, Hans Peter, Dept. Zoology, Univ. Wisc., Madison 6, Wisc. 1945
Thone, Dr. Frank, 1719 N. St. N. W., Washington 6, D. C. 1932
Thorpe, Dr. Malcolm R., 10 Silver Sands Rd., East Haven, Conn. 1921
Tiemeier, Otto W., 1706 Learnard Ave., Lawrence, Kans. 1938
Tihen, Joe, Dept. Biol., Univ. Rochester, Rochester, N. Y. 1940
Tillotson, Daniel F., R. 2, Box 288, Fillmore, Calif. 1937
Titus, Miss W. J., 14 Center St., Northport, Long Island, N. Y. 1940
Tomich, P. Quentin, R. 1, Box 57, Folsom, Calif. 1943
Tomkins, Ivan R., 1231 E. 50th St., Savannah, Ga. 1930
Torre, Luis de la, 813 Ridgwood Dr., Highland Park, Ill. 1942
Torrey, Edward P. E., 122 Victory Drive, Rome, N. Y. 1942
Trapido, Harold, Dept. Zoology, Cornell Univ., Ithaca, N. Y. 1941
Trowbridge, Albert H., c/o Dr. Minnie S. Trowbridge, Hanston, Kans. 1937
Tryon, Clarence A., Jr., Dept. Zoology, Montana State College, Bozeman, Mont. 1940
Tubbs, Farley F., Game Division, Dept. Conservation, Lansing 13, Mich. 1936
Uhler, Francis M., Fish & Wildlife Serv., Patuxent Refuge, Bowie, Md. 1926

ULMER, FREDERICK A., JR., Acad. Nat. Sci., 19th & The Parkway, Philadelphia, Penna. 1939
VAN NORDHEIM, JACK H., 3352 Prospect Ave., La Crescenta, Calif. 1942
VAN TYNE, DR. JOSSELYN, Mus. Zool., Univ. Mich., Ann Arbor, Mich. 1924
VESALL, DAVID B., 1214 South 2nd Street, Stillwater, Minn. 1941
VESPA, CARL, 10722 Bensely Ave., Chicago 17, Ill. 1944
VESTAL, ELDEN H. (Inactive) 1936
VILLA R., PROF. BERNARDO, Instituto de Biologia, Casa del Lago de Chapultepec, Mexico, D. F. 1942
VOGE, MRS. MARIETTA, 2626 Haste St., Berkeley, Calif. 1944
VON BLOEKER, JACK C., JR., 1625 Country Club Dr., Glendale 8, Calif. 1927
VORHIES, DR. CHARLES T., Univ. Arizona, Tucson, Ariz. Charter
WACHTEL, IRWIN J., Breeding and Laboratory Inst., 619 Kent Ave., Brooklyn, N. Y. 1940
WADE, DOUGLAS EDWARD, Natural History Bldg., Dartmouth College, Hanover, New Hampshire 1940
WADE, PROF. OTIS, Bessey Hall, State Univ., Lincoln, Nebr. 1926
WAGNER, EDWARD D., Mus. Zool., Univ. Mich., Ann Arbor, Mich. 1942
WALKER, ERNEST P., Apt. 404, 3016 Tilden St., N. W., Washington 8, D. C. Charter
WALKER, WARD R., Hershey, Penna. 1940
WALLACE, HERBERT S. (Inactive) 1940
WALTERS, ROLAND D., Dept. Biology, Walla Walla College, College Place, Wash. 1945
WANDELL, WILLET N., 35 Wilkins St., R. F. D., Hudson, Mass. 1943
WARBACH, OSCAR, 1017 Madison Ave., Elizabeth 4, N. J. 1940
WARFEL, PROF. HERBERT E., Bingham Oceanographic Lab., Peabody Museum, Yale Univ., New Haven, Conn. 1935
WASHBURN, DR. SHERWOOD L., Dept. Anatomy, 630 W. 168th St., New York, N. Y. 1942
WATSON, ARTHUR R., 1477 West 110th St., Cleveland 2, Ohio 1944
WATSON, DR. CLARENCE W., P. O. Box 833, Atlanta, Ga. 1944
WAY, IVAN M., Dept. Anatomy, Univ. Colo., School Med., Denver, Colo. 1927
WEED, PROF. LEWIS H., Dept. Anatomy, Johns Hopkins Med. School, Baltimore 5, Md. 1921
WHITE, DR. THEODORE E., Mus. Comp. Zool., Cambridge, Mass. 1926
WHITEHEAD, SGT. ARTHUR N., 38300434, 4th Eng. Overhaul Sqdn-4th ADG., A. P. O. 922 c/o P. M., San Francisco, Calif. 1944
WHITEMAN, ELDON E., Box 53, Spring Arbor, Mich. 1944
WHITNEY, DR. LEON F., Oakwood Road, Orange, Conn. 1932
WIGUTOFF, NORMAN B., U. S. Fish and Wildlife Serv., Market News Office, 200 N. Jefferson St., Chicago, Ill. 1942
WILLETT, G., Exposition Park, Los Angeles Museum, Los Angeles 7, Calif. 1935
WILLIAMS, COLEMAN S., Saugatuck, Conn. 1930
WILSON, BRUCE V., Okemos, Mich. 1944
WILSON, KENNETH A., Bedford Rd., R. F. D. #3, Cumberland, Md. 1938
WILSON, LOUIS W., Moorefield, West Va. 1940
WILSON, DR. ROBERT W., Dept. Geology, Univ. Colorado, Boulder, Colo. 1933
WIMSATT, WILLIAM A., 121 Cayuga Park Rd., Ithaca, N. Y. 1941
WING, DR. LEONARD W., Dept. Zoology, State College, Pullman, Wash. 1938
WINTON, PROF. W. M., Texas Christian Univ., Fort Worth, Tex. 1922
WISEMAN, CPL. JOHN S., 1346 Downing St., Denver 3, Colo. 1945
WISLOCKI, DR. G. B., Dept. Anatomy, Harvard Med. School, Boston, Mass. Charter
WOLFE, ELWOOD K., JR., 97 East Baltimore Ave., Lansdowne, Penna. 1941
WOLFE, DR. HAROLD R., Dept. Zoology, Univ. Wisc., Madison 6, Wisc. 1935
WOLFE, COL. L. R., 2nd & T Sts., S. W., Rm. 2057-Temp. "C" Bldg., Washington, D. C. 1923
WOOD, MAJ. ALBERT E., 398 Upper Mountain Ave., Upper Montclair, N. J. 1928

WOOD, CAPT. HORACE E., Post Hdqt., Craig Field, Selma, Ala. 1924
WRAY, WILLIAM J. (Inactive) 1939
WRIGHT, DR. ALBERT H., Dept. Zoology, Cornell Univ., Ithaca, N. Y. ..... Charter
WRIGHT, CHARLES W., Summit Ave., Berlin, N. J. 1941
WRIGHT, DR. PHILIP L., Montana State Univ., Missoula, Mont. 1941
WYMAN, DR. LELAND C., Dept. Physiology, Boston Univ. School of Med., Boston, Mass. ..... Charter
YANDELL, RALPH E., VMSB 343, F. P. O., San Francisco, Calif. 1944
YEAGER, DR. LEE E., U. S. Fish and Wildlife Service, Merchandise Mart, Chicago 54, Ill. 1937
YEPES, SR. JOSE, Directorio 2980, Buenos Aires, Argentina 1935
YERKES, DR. ROBERT M., 333 Cedar St., New Haven, Conn. ..... Charter
YOUNG, DR. CHUNG CHIEN, c/o Dr. E. H. Colbert, Amer. Mus. Nat. Hist., New York 24, N. Y. 1933
YOUNG, STANLEY P., U. S. Fish and Wildlife Service, Washington 25, D. C. 1928
YUNGE, CARLOS, 111 Avenida Alemana, Concepcion, Chile 1940
ZAHNISER, HOWARD, 6222-43rd Ave., Hyattsville, Md. 1935
ZIMMER, DR. JOHN T., Amer. Mus. Nat. Hist., New York 24, N. Y. ..... Charter

OBITUARY NOTICES

H. O. BORGFELD, JR.

1921–1945

Lt. H. O. Borgfeld, Jr., son of Mr. and Mrs. H. O. Borgfeld, Sr., Converse, Texas, was killed in action over Germany on January 29, 1945. He was flying his fourth or fifth mission as bombadier-navigator on a B-24.

Lt. Borgfeld was born March 25, 1921, at San Antonio, Texas, graduated from high school at that city and entered the Texas Agricultural and Mechanical College in September 1938. He majored in Fish and Game, graduating in June 1941. After graduation, he worked as Field Biologist for the Texas Cooperative Wildlife Research Unit on wildlife problems in the vicinity of Kerrville, Texas. He entered the Army Air Corps in 1943, completed his training at the San Marcos, Texas, Army Air Field in July 1944, and was transferred to England in December 1944.

He is survived by his wife and small son, his mother, father, and a younger brother. He became a member of the American Society of Mammalogy in 1939.—W. B. DAVIS.

CURTIS JULIAN HESSE

1905–1945

Curtis J. Hesse, a member of the Society since 1940, died suddenly of a heart attack, May 12 at Bryan, Texas. He was Curator of the College Museum of the Agricultural and Mechanical College of Texas at College Station.

He was born in Wamego, Kansas, September 28, 1905, his family later moving to Lawrence, Kansas. At an early age he became greatly interested in archeology, historical objects, and vertebrate fossils. Due to the kind guidance of Handle T. Martin, Curator of Vertebrate Paleontology at the University of Kansas Museum, he was able to achieve his boyhood ambitions.

Curtis Hesse was employed as a student from 1919 to 1927 as Museum Assistant in Vertebrate Paleontology and was also a member of the museum field expedition for the University

of Kansas during the summers of 1920, 1921, 1923, 1924, 1925, 1929, and 1930. In the fall of 1929 he entered the University of California as Teaching Fellow in Paleontology under Doctor W. D. Matthew. He became Museum Assistant at the University of California in 1931 and was a member of their field expeditions during the summers of 1931, 1932, 1934, and 1936. In 1938 he became Assistant Curator of the College Museum at the Texas Agricultural and Mechanical College at College Station, becoming Curator in 1943.

He was chiefly interested in the collecting and studying of Pliocene mammalian faunas of the "High Plains" region. He published a number of papers on the results of these studies.—CLAUDE W. HIBBARD.